

Final Monitoring Plan for Site Restoration at Murdock, Nebraska

prepared by
Environmental Science Division
Argonne National Laboratory



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by
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Notation

BGL	below ground level
CCC	Commodity Credit Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
ft	foot (feet)
gpm	gallon(s) per minute
GWEX	groundwater extraction well
hr	hour(s)
in.	inch(es)
µg/L	microgram(s) per liter
µg/m ³	microgram(s) per cubic meter
mi	mile(s)
USDA	U.S. Department of Agriculture
VOC	volatile organic compound
yr	year(s)

Final Monitoring Plan for Site Restoration at Murdock, Nebraska

1 Introduction

1.1 Background

In early 2005, Argonne National Laboratory conducted an Engineering Evaluation/Cost Analysis (EE/CA; Argonne 2005b) to address carbon tetrachloride contamination identified in groundwater and surface water at Murdock, Nebraska, approximately 22 mi east-northeast of Lincoln (Figure 1.1). The EE/CA study was performed for the Commodity Credit Corporation of the U.S. Department of Agriculture (CCC/USDA), as the technical basis for a proposed removal action for the Murdock site. The EE/CA was conducted in compliance with an *Administrative Order on Consent* issued for Murdock by the U.S. Environmental Protection Agency (EPA 1991).

Three removal action alternatives were examined through the use of site-specific data and predictive simulations of groundwater flow and contaminant transport performed with calibrated numerical models. The alternatives were evaluated individually and compared against performance criteria established under the National Oil and Hazardous Substances Pollution Contingency Plan and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). On the basis of these evaluations, an alternative employing phytoremediation in conjunction with seasonal groundwater extraction and treatment by spray irrigation was recommended by the CCC/USDA to permanently reduce the carbon tetrachloride contaminant levels in groundwater and surface water at the site. The proposed alternative is being implemented in cooperation with the EPA.

Under the direction of the CCC/USDA and the EPA, implementation of the chosen removal action occurred in phases, beginning in April 2005. Installation of all the required remediation systems was completed by the end of August 2005.

Specific technical objectives of the removal action are as follows:

- To eliminate pathways for potential human exposure to carbon tetrachloride concentrations above the regulatory limit of 44.2 µg/L in surface water at the site.
- To minimize or eliminate any detrimental environmental impacts of carbon tetrachloride discharge to the surface waters of a tributary creek located immediately north of the town.
- To permanently reduce carbon tetrachloride concentrations in the groundwater and surface water at Murdock and hence restore these resources for potential beneficial use.

To evaluate the effectiveness of the selected remedy and its ability to achieve the objectives specified for this site, monitoring is required. This document outlines the proposed scope of a long-term program for monitoring of the removal action at Murdock. In this section the specific remedial objectives of the action are summarized, and a brief overview of the chosen remedy is provided. Section 2 summarizes the results of a baseline sampling event that documented the distribution of carbon tetrachloride contamination in selected media at the Murdock site immediately before cleanup activities began. Section 3 recommends a strategy for subsequent monitoring of the removal action at Murdock, as well as criteria for evaluating the performance of the remedial systems and the progress of the restoration effort.

1.2 Overview of the Removal Action Components

The removal action implemented at Murdock involves several innovative technologies used in sequence along the plume migration pathway to decrease carbon tetrachloride levels in groundwater and in water naturally discharged to the surface at the headwaters of a small creek (a tributary to Pawnee Creek) north of the town. The primary elements of this system are (1) a groundwater extraction well and treatment unit, (2) a phytoremediation planting area, and (3) constructed wetlands (Figure 1.2).

A groundwater extraction well (GWEX-1) has been installed to remove contaminated groundwater from the upgradient, more concentrated portion of the plume. GWEX-1 is operated

seasonally at an estimated pumping rate of 35 gpm. A specially designed spray treatment apparatus (Figure 1.3) simultaneously volatilizes carbon tetrachloride from the produced groundwater and irrigates property owned by the Elmwood-Murdock Public School system.

Selected vegetation types planted in the headwaters area of the tributary creek reduce carbon tetrachloride concentrations in the relatively shallow groundwater and surface waters via phytoremediation processes. Approximately 2,000 trees, representing six species (Niobe willow, black willow, eastern cottonwood, hybrid poplar, green ash, and northern catalpa), cover an area of approximately 4.5 acres (Figures 1.2 and 1.4). Removal of the carbon tetrachloride occurs as a result of uptake, transpiration, and volatilization of the contaminated groundwater by the trees and degradation of the carbon tetrachloride within the plant tissues, as well as via enhanced microbial activity in the root zone created by the plantings. At locations where the static groundwater level is typically more than 4–5 ft below ground level (BGL), in the “deep” planting zone (Figure 1.2), a special technique was used to plant the trees in 24-in.-diameter boreholes lined with plastic sleeves. This “tree well” technique limits the availability of shallow soil water and direct precipitation to the trees, and hence it promotes vertical root growth and uptake of the deeper contaminated groundwater. In the remaining “surface” planting zone (Figure 1.2), the trees were installed without borehole liners to give the roots access to contaminated groundwater typically encountered at depths of less than 4 ft BGL.

Additional vegetation, including a mixture of native prairie grasses, wildflowers, and other species, was planted between the trees and in the adjacent areas. These cover plantings (1) enhance erosion control, (2) intercept local precipitation and runoff and hence promote the uptake of deeper contaminated groundwater by the trees, (3) help protect the trees from physical damage, (4) provide a transitional buffer zone between the tree planting area and the surrounding croplands, and (5) create a barrier to herbicide drift.

Shallow wetlands constructed downstream from the main planting area provide an additional phytoremediation “polishing” stage for the water discharged to the tributary creek (Figures 1.2 and 1.5). By increasing the local residence time and surface exposure area of the flow entering the downstream portion of the tributary, the wetlands promote further carbon tetrachloride evaporation and degradation by water-loving plants and associated microbes.

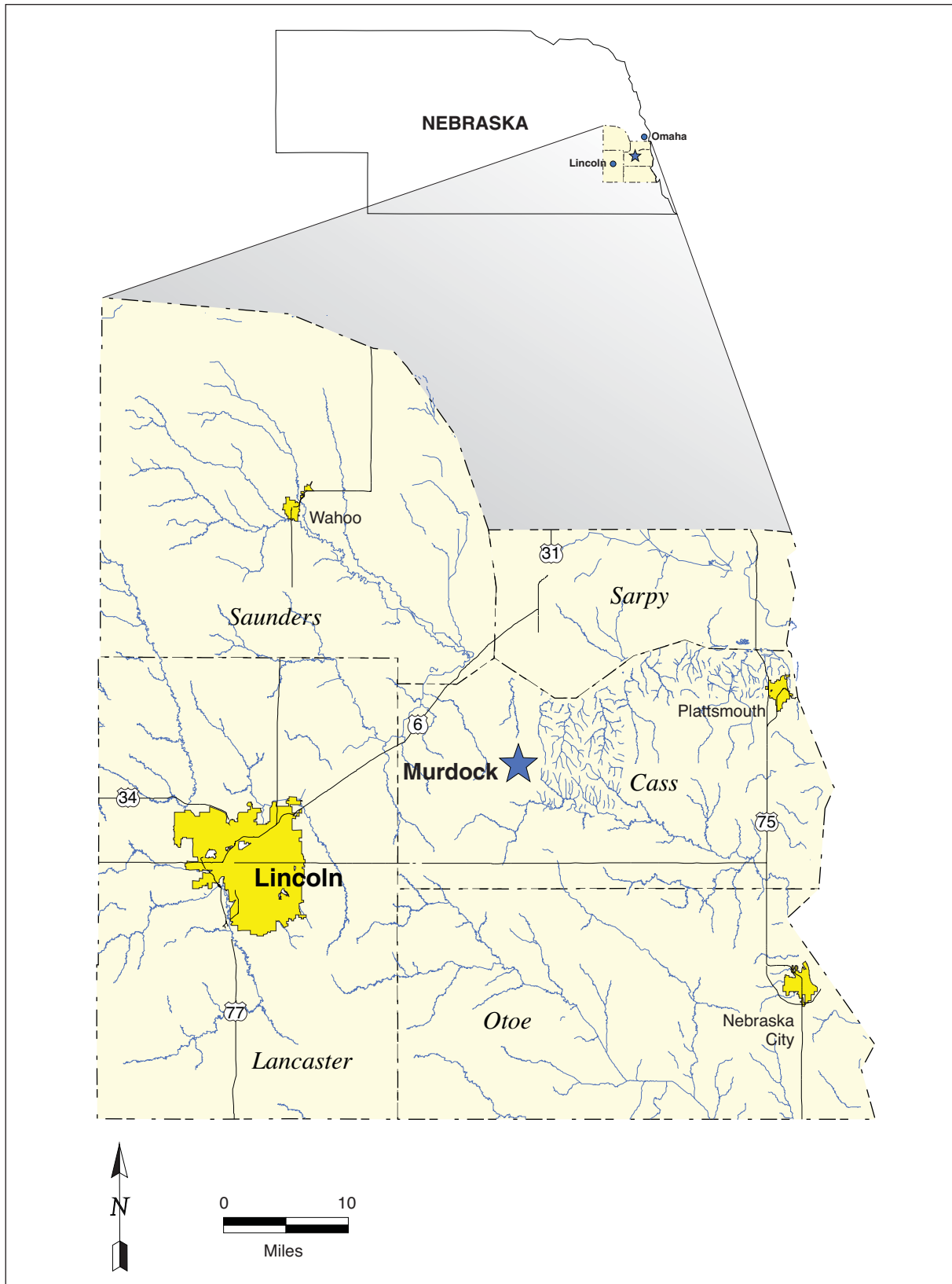


FIGURE 1.1 Location of Cass County and Murdock, Nebraska.



FIGURE 1.2 Locations of the GWEX-1 well, the spray irrigation treatment area, the shallow and deep phytoremediation planting areas, and the constructed wetlands at Murdock, with the location of the former CCC/USDA grain storage facility. Source of photograph: NAIP (2003).



FIGURE 1.3 Traveling spray irrigation unit used to process groundwater pumped seasonally from extraction well GWEX-1 at Murdock.



FIGURE 1.4 Distribution of trees planted in the southwestern portion of the phytoremediation treatment area at Murdock, at the headwaters of the tributary creek (July 2005).



FIGURE 1.5 Southwestern portion of the wetlands treatment area, shortly after construction and grading of the wetlands basin (fall 2005).

2 Baseline Sampling Studies

An initial event to collect samples for analyses for volatile organic compounds (VOCs) was conducted at Murdock in July 2005, shortly after the groundwater extraction system was installed and the main phytoremediation areas were planted. This sampling was performed to (1) provide a current “snapshot” of the carbon tetrachloride distribution in the previously identified groundwater plume and the surface waters at the headwaters of the tributary creek and (2) establish baseline data for future comparisons that will permit evaluation of the performance of the remedial systems implemented at the site and progress toward restoration of the Murdock aquifer.

The July 2005 sampling activities included (1) groundwater and surface water sampling throughout the area affected by the carbon tetrachloride plume, (2) tissue sampling of the newly planted vegetation in the phytoremediation area, and (3) ambient air sampling in the planted and preexisting vegetated areas along the tributary creek. The results of these analyses are summarized below.

2.1 Groundwater Analysis Results

To determine current levels of carbon tetrachloride contamination in the upgradient portion of the groundwater plume, groundwater samples for VOCs analyses were collected at nine permanent observation locations along and south of Waverly Road (MW2, SB63–SB65, SB68–SB72), as well as at GWEX-1 (Figure 2.1). These observation points were installed during previous work at Murdock to facilitate periodic sampling along both the approximate central axis of the identified groundwater plume and near its lateral margins. At each of these locations, a cluster of two or more borings provides vertical resolution of the contaminant distribution within the plume. Construction information for these selected observation points, as well as for the full suite of permanent observation points available at the Murdock site, is summarized in Appendix A.

To complement the preexisting observation points, 15 new permanent observation wells were installed at 9 locations near the headwaters of the tributary creek north of Waverly Road, both in and adjacent to the phytoremediation planting area (Figure 2.1). Well clusters PMW1, PMW2, PMW9, and PMW3 were installed along a linear trend roughly following the central path of groundwater flow and contaminant migration toward the tributary creek. Wells

PMW4–PMW7 are located on an approximate transect across the contaminant plume in the area where groundwater discharge to the creek has been consistently observed, and well PMW8 is near the identified downgradient erosional limit of the Murdock aquifer (Argonne 2005a). Construction data and well registration information for these wells are in Appendix A.

The results of the groundwater analyses are summarized in Table 2.1, and the maximum carbon tetrachloride level detected at each sampling location is illustrated in Figure 2.2. The general configuration of the carbon tetrachloride plume shown in Figure 2.2 is consistent with measurements made in 2002 and 2004 (Argonne 2005a). The present data, however, provide a more detailed picture of the carbon tetrachloride distribution in the headwaters area of the tributary creek. Concentrations of carbon tetrachloride above 1,000 µg/L were detected at monitoring wells PMW1D and PMW2D, indicating that along the axis of the carbon tetrachloride plume, highly elevated levels of the contaminant are now approaching the phytoremediation planting area.

Two additional groundwater samples were collected from within the root system at two of the deep tree planting locations (W410 and W103, Figure 2.2), through vertical ventilation tubes installed for root aeration in each of the tree wells. Carbon tetrachloride was found at tree well W410 but was not detected at tree well W103 (Table 2.1). These results suggest that some uptake of contaminated groundwater by the trees at W410 began before baseline sampling. The high ratio of chloroform to carbon tetrachloride (31 µg/L versus 38 µg/L, respectively) at this location suggests that some degradation of carbon tetrachloride also preceded the baseline sampling.

2.2 Surface Water Analysis Results

One surface water sample was collected, at location SWP13 (Figure 2.2). The estimated carbon tetrachloride concentration for this sample (351 µg/L; Table 2.1) was similar to levels detected at this location in 2004 (Argonne 2005a). Earlier periodic sampling at this location consistently identified SWP13 as the approximate point of maximum carbon tetrachloride discharge (on the basis of measured concentrations) to the surface waters of the tributary creek.

TABLE 2.1 Results of organic analyses on groundwater and surface water samples collected in the baseline sampling at Murdock, Nebraska, in July 2005.

Location	Sample	Depth (ft BGL)	Sample Date	Concentration (µg/L)	
				Carbon Tetra-chloride	Chloro-form
Groundwater samples					
2S	MU2S-W-18308	70.5–80.5	7/18/05	85	2.5
2D	MUD2-W-18344	85–95	7/22/05	10	3.4
SB63S	MUSB63S-W-18338	23–38	7/21/05	ND ^a	ND
SB63D	MUSB63D-W-18337	36.5–51.5	7/21/05	11	ND
SB64S	MUSB64S-W-18343	30–50	7/22/05	5.2	0.7 J ^b
SB64M	MUSB64M-W-18341	48.5–68.5	7/22/05	1.2	0.2 J
SB64D	MUSB64D-W-18340	67–87	7/22/05	0.6 J	ND
SB65S	MUSB65S-W-18335	23.7–38.7	7/21/05	ND	ND
SB65D	MU65D-W-18309	38–53	7/18/05	201	1
SB68S	MUSB68S-W-18059	49–56.5	7/21/05	568	6
SB68M	MUSB68M-W-18060	57.2–67.2	7/21/05	1013	12
SB68D	MUSB68D-W-18061	67.8–77.8	7/21/05	5.4	ND
SB69M	MUSB69M-W-18062	51.9–61.9	7/21/05	845	9.8
SB69D	MUSB69D-W-18063	62.2–72.2	7/21/05	111	3.6
SB70S	MUSB70S-W-18064	50.8–58.3	7/21/05	128	4.1
SB70M	MUSB70M-W-18065	58.4–68.4	7/21/05	65	1
SB70D	MUSB70D-W-18066	68.9–78.9	7/21/05	0.5 J	ND
SB71S	MUSB71S-W-18072	53.1–60.6	7/21/05	579	6.5
SB71D	MUSB71D-W-18073	70–80	7/21/05	3.2	0.3 J
SB72S	MUSB72S-W-18069	49–56.5	7/21/05	1.3	ND
SB72M	MUSB72M-W-18070	59.7–69.7	7/21/05	1.5	ND
SB72D	MUSB72D-W-18071	70–80	7/21/05	1.5	ND
GWEX-1	MUGWEX-W-18312	47–77	7/18/05	205	2.3
TEST-1	MUTEST1-W-18311	60–65	7/18/05	81	49
PMW1S	MUPMW1S-W-18318	4.6–14.6	7/19/05	9.4	0.4 J
PMW1D	MUPMW1D-W-18313	24.6–34.6	7/19/05	1233	5.2
PMW2SB	MUPMW2SB-W-18334	4.6–14.6	7/21/05	377	6.4
PMW2D	MUPMW2D-W-18314	19.6–29.6	7/19/05	1564	4.8
PMW3S	MUPMW3S-W-18331	4.5–14.5	7/21/05	394	2.4
PMW3D	MUPMW3D-W-18316	19.5–24.5	7/19/05	801	4.9
PMW4	MUPMW4-W-18321	19.5–24.5	7/20/05	52	1.8
PMW5	MUPMW5-W-18322	4.5–14.5	7/20/05	118	1
PMW6	MUPMW6-W-18333	4.5–14.5	7/21/05	9.6	0.4 J

TABLE 2.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Concentration (µg/L)	
				Carbon Tetra-chloride	Chloro-form
Groundwater samples (Cont.)					
PMW7	MUPMW7-W-18332	14.5–19.5	7/21/05	3.5	0.6 J
PMW8	MUPMW8-W-18323	4.5–14.5	7/20/05	23	0.8 J
PMW9S	MUPMW9S-W-18328	5–9	7/20/05	10	14
PMW9M	MUPMW9M-W-18329	11–15	7/20/05	60	2
PMW9D	MUPMW9D-W-18315	20–30	7/20/05	4.6	0.9 J
W103	MU578-W-18260	5.66–7.78	7/19/05	ND	ND
W410	MUTW444-W-18261	Unknown	7/25/05	38	31
Surface water samples					
SWP13	MUSWP13-W-18068	-	7/21/05	351 C ^c	10

^a ND, contaminant not detected at an instrument detection limit of 0.1 µg/L.

^b Qualifier J indicates an estimated concentration below the method quantitation limit of 1 µg/L.

^c Qualifier C indicates an estimated concentration outside the calibration range for carbon tetrachloride at zero dilution; insufficient sample for reanalysis at dilution.

2.3 Plant Tissue Analysis Results

As noted in Section 1.2, the vegetation planted in the phytoremediation area is expected to take up, transpire, and degrade carbon tetrachloride as the plants take root and mature. Previous sampling of preexisting natural vegetation along the tributary creek (Argonne 2005b) indicated that these processes should result in elevated levels of carbon tetrachloride in plant tissues over time. To obtain baseline data, plant tissue samples were collected from new trees in the phytoremediation area and analyzed for VOCs.

The vegetation sampling included all six species of trees. Sampling occurred in every other row, at every fourth or fifth tree in the sampled row. Background samples were collected at two locations in nearby areas that have not been affected by the groundwater plume. Samples of branches and leaves collected in July 2005 were analyzed by a headspace technique based on a modification of EPA Method 5021-1 (<http://www.epa.gov/epahome/index/>). The concentrations of carbon tetrachloride and chloroform in the plant tissue samples are summarized in Table 2.2,

TABLE 2.2 Results of organic analyses on vegetation samples collected in the baseline sampling at Murdock, Nebraska, in July 2005.

Location	Sample ^a	Sample Date	Concentration (µg/kg)	
			Carbon Tetra-chloride	Chloro-form
<i>Samples in planting zones</i>				
E101	MU-593-B-18379	7/19/05	ND ^b	1.7
E101	MU-593-L-18378	7/19/05	ND	1.3
E106	MU-598-B-18381	7/19/05	ND	1.5
E106	MU-598-L-18380	7/19/05	ND	3.5
E111	MU-603-B-18383	7/19/05	< 1 ^c	2.1
E111	MU-603-L-18382	7/19/05	ND	1.3
E116	MU-608-B-18385	7/19/05	ND	ND
E116	MU-608-L-18384	7/19/05	ND	ND
E121	MU-613-B-18387	7/19/05	ND	ND
E121	MU-613-L-18386	7/19/05	ND	3.4
E126	MU-618-B-18389	7/19/05	ND	ND
E126	MU-618-L-18388	7/19/05	ND	ND
E129	MU-633-B-18395	7/19/05	ND	ND
E129	MU-633-L-18394	7/19/05	ND	3.2
E245	MU-638-B-18397	7/19/05	ND	ND
E245	MU-638-L-18396	7/19/05	ND	1.3
E304	MU-690-B-18483	7/19/05	ND	1.1
E304	MU-690-L-18482	7/19/05	ND	3.4
E309	MU-695-B-18485	7/19/05	43.2	12.3
E309	MU-695-L-18484	7/19/05	ND	2.0
E314	MU-700-B-18487	7/19/05	ND	2.6
E314	MU-700-L-18486	7/19/05	ND	2.2
E319	MU-705-B-18489	7/19/05	ND	1.4
E319	MU-705-L-18488	7/19/05	ND	ND
E324	MU-710-B-18491	7/20/05	ND	2.3
E324	MU-710-L-18490	7/20/05	ND	1.3
E329	MU-715-B-18493	7/20/05	ND	< 1
E329	MU-715-L-18492	7/20/05	ND	< 1
E340	MU-720-B-18495	7/20/05	ND	3.1
E340	MU-720-L-18494	7/20/05	ND	1.8
E345	MU-725-B-18497	7/20/05	ND	2.1
E345	MU-725-L-18496	7/20/05	ND	3.0
E438	MU-623-B-18391	7/19/05	ND	2.0
E438	MU-623-L-18390	7/19/05	ND	ND
E502	MU-789-B-18499	7/20/05	ND	3.0
E502	MU-789-L-18498	7/20/05	ND	1.3
E507	MU-794-B-18501	7/20/05	ND	1.5
E507	MU-794-L-18500	7/20/05	ND	2.7
E512	MU-799-B-18503	7/20/05	ND	2.7
E512	MU-799-L-18502	7/20/05	ND	ND
E517	MU-804-B-18505	7/20/05	ND	ND
E517	MU-804-L-18504	7/20/05	ND	2.0
E522	MU-809-B-18507	7/20/05	ND	1.5

TABLE 2.2 (Cont.)

Location	Sample ^a	Sample Date	Concentration (µg/kg)	
			Carbon Tetra- chloride	Chloro- form
Samples in planting zones (Cont.)				
E522	MU-809-L-18506	7/20/05	ND	2.6
E527	MU-814-B-18509	7/20/05	ND	< 1
E527	MU-814-L-18508	7/20/05	ND	ND
E532	MU-819-B-18511	7/20/05	ND	ND
E532	MU-819-L-18510	7/20/05	ND	3.5
E537	MU-824-B-18513	7/20/05	ND	ND
E537	MU-824-L-18512	7/20/05	ND	1.6
E542	MU-829-B-18515	7/20/05	ND	1.6
E542	MU-829-L-18514	7/20/05	ND	1.2
E547	MU-834-B-18517	7/20/05	ND	1.2
E547	MU-834-L-18516	7/20/05	ND	ND
E550	MU-839-B-18519	7/20/05	ND	ND
E550	MU-839-L-18518	7/20/05	ND	ND
E555	MU-844-B-18521	7/20/05	ND	2.9
E555	MU-844-L-18520	7/20/05	ND	2.0
E557	MU-Corn846-B-18555	7/20/05	ND	ND
E557	MU-Corn846-L-18554	7/20/05	ND	ND
E659	MU-849-B-18523	7/20/05	ND	ND
E659	MU-849-L-18522	7/20/05	ND	3.3
E700	MU-911-B-18551	7/20/05	ND	ND
E700	MU-911-L-18550	7/20/05	ND	ND
E705	MU-916-B-18549	7/20/05	ND	ND
E705	MU-916-L-18548	7/20/05	ND	1.2
E710	MU-921-B-18547	7/20/05	ND	ND
E710	MU-921-L-18546	7/20/05	ND	< 1
E715	MU-926-B-18545	7/20/05	ND	ND
E715	MU-926-L-18544	7/20/05	ND	1.3
E720	MU-931-B-18543	7/20/05	ND	ND
E720	MU-931-L-18542	7/20/05	ND	ND
E725	MU-936-B-18541	7/20/05	ND	2.5
E725	MU-936-L-18540	7/20/05	ND	2.9
E730	MU-941-B-18539	7/20/05	ND	3.0
E730	MU-941-L-18538	7/20/05	ND	2.5
E735	MU-946-B-18537	7/20/05	ND	ND
E735	MU-946-L-18536	7/20/05	ND	ND
E740	MU-951-B-18535	7/20/05	ND	1.1
E740	MU-951-L-18534	7/20/05	ND	2.7
E758	MU-993-B-18553	7/20/05	ND	< 1
E758	MU-993-L-18552	7/20/05	ND	ND
E845	MU-1087-B-18533	7/20/05	ND	ND
E845	MU-1087-L-18532	7/20/05	ND	< 1
E858	MU-1082-B-18531	7/20/05	ND	2.1
E858	MU-1082-L-18530	7/20/05	ND	1.3
E862	MU-1078-B-18529	7/20/05	ND	ND
E862	MU-1078-L-18528	7/20/05	ND	ND

TABLE 2.2 (Cont.)

Location	Sample ^a	Sample Date	Concentration (µg/kg)	
			Carbon Tetra- chloride	Chloro- form
<i>Samples in planting zones (Cont.)</i>				
E866	MU-1072-B-18527	7/20/05	ND	1.6
E866	MU-1072-L-18526	7/20/05	ND	ND
E871	MU-1067-B-18525	7/20/05	ND	ND
E871	MU-1067-L-18524	7/20/05	ND	ND
W103	MU-578-B-18373	7/19/05	ND	ND
W103	MU-578-L-18372	7/19/05	ND	< 1
W107	MU-588-B-18377	7/19/05	ND	1.8
W107	MU-588-L-18376	7/19/05	ND	1.4
W111	MU-584-B-18375	7/19/05	3.2	4.3
W111	MU-584-L-18374	7/19/05	ND	1.3
W114	MU-563-B-18367	7/19/05	< 1	2.1
W114	MU-563-L-18366	7/19/05	ND	ND
W119	MU-558-B-18365	7/19/05	1.5	2.7
W119	MU-558-L-18364	7/19/05	ND	ND
W124	MU-553-B-18363	7/19/05	3.9	3.4
W124	MU-553-L-18362	7/19/05	ND	ND
W129	MU-548-B-18361	7/19/05	3.0	2.9
W129	MU-548-L-18360	7/19/05	ND	ND
W134	MU-543-B-18359	7/19/05	< 1	< 1
W134	MU-543-L-18358	7/19/05	ND	ND
W139	MU-538-B-18357	7/19/05	ND	ND
W139	MU-538-L-18356	7/19/05	ND	1.2
W144	MU-533-B-18355	7/19/05	ND	1.5
W144	MU-533-L-18354	7/19/05	ND	1.7
W148	MU-529-B-18353	7/19/05	ND	< 1
W148	MU-529-L-18352	7/19/05	ND	1.8
W153	MU-524-B-18351	7/19/05	ND	ND
W153	MU-524-L-18350	7/19/05	ND	2.8
W158	MU-519-B-18349	7/19/05	< 1	ND
W158	MU-519-L-18348	7/19/05	ND	ND
W203	MU-573-B-18371	7/19/05	ND	ND
W203	MU-573-L-18370	7/19/05	ND	ND
W210	MU-568-B-18369	7/19/05	3.7	ND
W210	MU-568-L-18368	7/19/05	ND	ND
W303	MU-462-B-18425	7/19/05	ND	ND
W303	MU-462-L-18424	7/19/05	ND	ND
W308	MU-467-B-18427	7/19/05	ND	ND
W308	MU-467-L-18426	7/19/05	ND	1.4
W361	MU-301-B-18445	7/19/05	ND	ND
W361	MU-301-L-18444	7/19/05	ND	ND
W402	MU-452-B-18421	7/19/05	ND	1.1
W402	MU-452-L-18420	7/19/05	ND	ND
W407	MU-447-B-18419	7/19/05	< 1	1.5
W407	MU-447-L-18418	7/19/05	ND	3.5

TABLE 2.2 (Cont.)

Location	Sample ^a	Sample Date	Concentration (µg/kg)	
			Carbon Tetra- chloride	Chloro- form
<i>Samples in planting zones (Cont.)</i>				
W412	MU-442-B-18417	7/19/05	ND	ND
W412	MU-442-L-18416	7/19/05	ND	1.3
W417	MU-437-B-18415	7/19/05	< 1	< 1
W417	MU-437-L-18414	7/19/05	ND	ND
W422	MU-432-B-18413	7/19/05	< 1	1.7
W422	MU-432-L-18412	7/19/05	ND	5.0
W427	MU-427-B-18411	7/19/05	< 1	1.6
W427	MU-427-L-18410	7/19/05	ND	1.1
W432	MU-422-B-18409	7/19/05	ND	1.6
W432	MU-422-L-18408	7/19/05	ND	ND
W437	MU-417-B-18407	7/19/05	ND	ND
W437	MU-417-L-18406	7/19/05	ND	< 1
W442	MU-412-B-18405	7/19/05	ND	ND
W442	MU-412-L-18404	7/19/05	ND	ND
W447	MU-407-B-18403	7/19/05	ND	ND
W447	MU-407-L-18402	7/19/05	ND	1.6
W452	MU-402-B-18401	7/19/05	ND	ND
W452	MU-402-L-18400	7/19/05	ND	ND
W457	MU-397-B-18399	7/19/05	ND	ND
W457	MU-397-L-18398	7/19/05	ND	2.0
W505	MU-338-B-18429	7/19/05	ND	< 1
W505	MU-338-B-18561	7/20/05	ND	< 1
W505	MU-338-L-18428	7/19/05	ND	1.7
W505	MU-338-L-18560	7/20/05	ND	2.0
W601	MU-331-B-18433	7/19/05	ND	1.4
W601	MU-331-L-18432	7/19/05	ND	< 1
W606	MU-326-B-18435	7/19/05	< 1	1.2
W606	MU-326-L-18434	7/19/05	ND	< 1
W611	MU-321-B-18437	7/19/05	ND	ND
W611	MU-321-L-18436	7/19/05	ND	1.2
W616	MU-316-B-18439	7/19/05	< 1	1.8
W616	MU-316-L-18438	7/19/05	ND	1.9
W621	MU-311-B-18441	7/19/05	ND	1.1
W621	MU-311-L-18440	7/19/05	ND	ND
W626	MU-306-B-18443	7/19/05	ND	1.1
W626	MU-306-L-18442	7/19/05	ND	1.1
W636	MU-296-B-18447	7/19/05	ND	ND
W636	MU-296-L-18446	7/19/05	ND	ND
W641	MU-291-B-18449	7/19/05	ND	ND
W641	MU-291-L-18448	7/19/05	ND	ND
W646	MU-286-B-18451	7/19/05	ND	1.2
W646	MU-286-L-18450	7/19/05	ND	1.8
W651	MU-281-B-18453	7/19/05	ND	ND
W651	MU-281-L-18452	7/19/05	ND	ND
W656	MU-276-B-18455	7/19/05	ND	ND

TABLE 2.2 (Cont.)

Location	Sample ^a	Sample Date	Concentration (µg/kg)	
			Carbon Tetra- chloride	Chloro- form
Samples in planting zones (Cont.)				
W656	MU-276-L-18454	7/19/05	ND	1.8
W801	MU-133-B-18481	7/19/05	ND	ND
W801	MU-133-L-18480	7/19/05	ND	ND
W806	MU-128-B-18479	7/19/05	ND	< 1
W806	MU-128-L-18478	7/19/05	ND	2.0
W810	MU-123-B-18477	7/19/05	ND	ND
W810	MU-123-L-18476	7/19/05	ND	1.4
W815	MU-118-B-18475	7/19/05	ND	ND
W815	MU-118-L-18474	7/19/05	ND	ND
W820	MU-113-B-18473	7/19/05	ND	ND
W820	MU-113-L-18472	7/19/05	ND	2.7
W825	MU-108-B-18471	7/19/05	ND	1.1
W825	MU-108-L-18470	7/19/05	ND	1.5
W830	MU-103-B-18469	7/19/05	ND	1.1
W830	MU-103-L-18468	7/19/05	ND	1.8
W835	MU-98-B-18467	7/19/05	ND	1.0
W835	MU-98-L-18466	7/19/05	ND	ND
W840	MU-227-B-18465	7/19/05	ND	1.1
W840	MU-227-L-18464	7/19/05	ND	1.9
W845	MU-222-B-18463	7/19/05	ND	3.7
W845	MU-222-L-18462	7/19/05	ND	2.9
W849	MU-217-B-18461	7/19/05	ND	< 1
W849	MU-217-L-18460	7/19/05	ND	1.8
W854	MU-212-B-18459	7/19/05	ND	2.0
W854	MU-212-L-18458	7/19/05	ND	2.0
W859	MU-207-B-18457	7/19/05	ND	2.0
W859	MU-207-L-18456	7/19/05	ND	2.3
W908	MU-9-B-18431	7/19/05	ND	ND
W908	MU-9-L-18430	7/19/05	ND	1.2
Background samples				
Bruttig-1	MU-Bruttig-B-18563	7/20/05	ND	1.3
Bruttig-1	MU-Bruttig-L-18562	7/20/05	ND	1.6
Bruttig-2	MU-Bruttig-B-18565	7/20/05	ND	3.1
Bruttig-2	MU-Bruttig-L-18564	7/20/05	ND	2.2
Bruttig-3	MU-Bruttig-B-18567	7/20/05	ND	2.0
Bruttig-3	MU-Bruttig-L-18566	7/20/05	ND	2.5
Creek-1	MU-WCreek-B-18573	7/20/05	ND	ND
Creek-1	MU-WCreek-L-18572	7/20/05	ND	ND

TABLE 2.2 (Cont.)

Location	Sample ^a	Sample Date	Concentration (µg/kg)	
			Carbon Tetra- chloride	Chloro- form
<i>Background samples (Cont.)</i>				
Creek-2	MU-WCreek-B-18575	7/20/05	ND	< 1
Creek-2	MU-WCreek-L-18574	7/20/05	ND	ND
Creek-3	MU-WCreek-B-18577	7/20/05	ND	1.2
Creek-3	MU-WCreek-L-18576	7/20/05	ND	3.1

^a Letter “B” in sample identifier indicates branch tissue; letter “L” indicates leaf tissue.

^b ND, contaminant not detected at a quantitation limit of 0.1 µg/kg for carbon tetrachloride or 0.75 µg/kg for chloroform

^c < 1 indicates a concentration of 0.1–0.99 µg/kg for carbon tetrachloride or 0.75–0.99 µg/kg for chloroform.

and the maximum carbon tetrachloride concentrations identified at each location are shown in Figure 2.3.

A total of 206 plant tissue samples were collected at 102 locations in the shallow and deep planting zones. Insignificant headspace concentrations of carbon tetrachloride (< 1 µg/kg) were found in most of the tissue samples. The results indicated, however, that some uptake of contaminated groundwater — by Niobe willows at six locations in the surface planting zone — had already occurred at the time of sampling. The detected carbon tetrachloride concentrations at these locations were generally low (< 4 µg/kg). The only exception was a concentration of 43.2 µg/kg at location E309 (Figure 2.3).

Twelve plant tissue samples were collected at six locations in two uncontaminated “background” sites near the phytoremediation area: (1) along the western branch of the tributary creek and (2) at a private residence (Bruttig) along Waverly Road, east of the plume migration pathway (Figure 2.3). No carbon tetrachloride was found in these samples. Headspace concentrations of chloroform ranged from < 1 µg/kg to 3.1 µg/kg, reflecting apparently

ubiquitous low levels of chloroform in the natural vegetation in the vicinity of the tributary creek headwaters (Table 2.2).

2.4 Ambient Air Analysis Results

Under the existing preremedial conditions at Murdock, carbon tetrachloride may be introduced to the ambient air in the creek headwaters area as a result of both direct volatilization from the groundwater and surface water and via uptake and transpiration by the preexisting vegetation. The results discussed in Section 2.3 suggest that the phytoremediation plantings had relatively little impact on ambient air prior to the time of the baseline sampling. Increased volatilization of carbon tetrachloride to the atmosphere should occur, however, as these plantings mature.

Ambient air was collected in July 2005 at three locations in the phytoremediation zone (AM1, AM3, AM4; Figure 2.4) and at one location in the preexisting vegetation (AM2) along the part of the creek impacted by the carbon tetrachloride plume. A “background” air sample was also collected outside the plume area, along a waterway about 1,300 ft west of the town and 150 ft south of Waverly Road (AM5; Figure 2.4). The sampling was conducted by placing preevacuated canisters at 4–5 ft above ground surface (near the vegetation canopy level) and collecting ambient air over a 4-hr time period. To minimize wind effects, sampling at each location occurred during the early morning on each of three consecutive days. The air samples were shipped to Severn-Trent Laboratory in Burlington, Vermont, for VOCs analyses by EPA Method TO-15. The results are summarized in Table 2.3. The maximum concentrations of carbon tetrachloride found at each location are shown in Figure 2.4.

The results for the ambient air samples indicate that carbon tetrachloride and chloroform in the “background” samples (location AM5) were below the detection limits of $1.3 \mu\text{g}/\text{m}^3$ and $0.98 \mu\text{g}/\text{m}^3$, respectively. Air samples collected in the phytoremediation planting area (locations AM1, AM3, and AM4) also contained no detectable carbon tetrachloride or chloroform, except that one sample recovered at AM3 on one of the three sampling days had a carbon tetrachloride concentration at the detection limit of $1.3 \mu\text{g}/\text{m}^3$.

Air sampling in the preexisting vegetation area was performed at location AM2 (Figure 2.4). Previous sampling by Argonne (2005b) identified high levels of carbon tetrachloride in the tissues of mature trees growing at this location. The results for all three days of air sampling at AM2 indicated low concentrations of carbon tetrachloride in the ambient air near the creek, ranging from 1.4 $\mu\text{g}/\text{m}^3$ to 3.5 $\mu\text{g}/\text{m}^3$; no chloroform was detected (Table 2.3).

TABLE 2.3 Results of organic analyses on air samples collected on three consecutive days, at five locations at Murdock, in the baseline sampling in July 2005.

	Concentration on Days 1, 2, and 3					
	Day 1		Day 2		Day 3	
	ppbv	$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$	ppbv	$\mu\text{g}/\text{m}^3$
<i>Location AM1, between trees W507 and W508</i>						
Dichlorodifluoromethane	0.55	2.7	0.59	2.9	0.58	2.9
Chloromethane	0.5 U ^a	1 U	0.55	1.1	0.5 U	1 U
Trichlorofluoromethane	0.24	1.3	0.27	1.5	0.28	1.6
Chloroform	0.2 U	0.98 U	0.2 U	0.98 U	0.2 U	0.98 U
Carbon Tetrachloride	0.2 U	1.3 U	0.2 U	1.3 U	0.2 U	1.3 U
Acetone	5 U	12 U	8.6	20	5 U	12 U
Methyl Ethyl Ketone	0.5 U	1.5 U	0.84	2.5	0.52	1.5
<i>Location AM2, in the preexisting trees along the east side of the creek near SWP03, east of SWP03 and 20 ft west of tree E210</i>						
Dichlorodifluoromethane	0.57	2.8	0.57	2.8	0.57	2.8
Chloromethane	0.5 U	1 U	0.5 U	1 U	0.96	2
Trichlorofluoromethane	0.26	1.5	0.27	1.5	0.28	1.6
Chloroform	0.2 U	0.98 U	0.2 U	0.98 U	0.2 U	0.98 U
Carbon Tetrachloride	0.46	2.9	0.22	1.4	0.55	3.5
1,2-Dichloropropane	0.2 U	0.92 U	0.2 U	0.92 U	0.68	3.1
Toluene	0.2 U	0.75 U	0.2 U	0.75 U	0.52	2
Acetone	5 U	12 U	5 U	12 U	11	26
Methyl Ethyl Ketone	0.5 U	1.5 U	0.59	1.7	0.92	2.7
n-Hexane	0.2 U	0.7 U	0.2 U	0.7 U	0.33	1.2
<i>Location AM3, east of the creek between trees E423 and E528</i>						
Dichlorodifluoromethane	0.59	2.9	0.58	2.9	0.58	2.9
Chloromethane	0.5 U	1 U	0.51	1.1	0.5 U	1 U
Trichlorofluoromethane	0.26	1.5	0.27	1.5	0.36	2
Chloroform	0.2 U	0.98 U	0.2 U	0.98 U	0.2 U	0.98 U
Carbon Tetrachloride	0.2	1.3	0.2 U	1.3 U	0.2 U	1.3 U
Toluene	0.2 U	0.75 U	0.2 U	0.75 U	0.43	1.6
Methyl Ethyl Ketone	0.59	1.7	0.53	1.6	0.5 U	1.5 U
n-Hexane	0.2 U	0.7 U	0.2 U	0.7 U	0.25	0.88

TABLE 2.3 (Cont.)

	Concentration on Days 1, 2, and 3					
	Day 1		Day 2		Day 3	
	ppbv	µg/m ³	ppbv	µg/m ³	ppbv	µg/m ³
<i>Location AM4, west of the creek between trees W635 and W636</i>						
Dichlorodifluoromethane	0.59	2.9	0.58	2.9	0.6	3
Chloromethane	0.53	1.1	0.5 U	1 U	0.53	1.1
Trichlorofluoromethane	0.26	1.5	0.26	1.5	0.3	1.7
Methylene Chloride	0.5 U	1.7 U	0.5 U	1.7 U	0.77	2.7
Chloroform	0.2 U	0.98 U	0.2 U	0.98 U	0.2 U	0.98 U
Carbon Tetrachloride	0.2 U	1.3 U	0.2 U	1.3 U	0.2 U	1.3 U
Benzene	0.2 U	0.64 U	0.2 U	0.64 U	0.32	1
Toluene	0.2 U	0.75 U	0.2 U	0.75 U	2	7.5
Xylene (<i>m</i> -, <i>p</i> -)	0.2 U	0.87 U	0.2 U	0.87 U	0.33	1.4
Methyl Ethyl Ketone	0.66	1.9	0.67	2	1.7	5
2,2,4-Trimethylpentane	0.2 U	0.93 U	0.2 U	0.93 U	0.25	1.2
<i>n</i> -Hexane	0.2 U	0.7 U	0.2 U	0.7 U	0.8	2.8
Xylene (total)	0.2 U	0.87 U	0.2 U	0.87 U	0.34	1.5
<i>Location AM5, a background monitoring location on the east edge of the waterway, about 150 ft south from the center of Waverly Road</i>						
Dichlorodifluoromethane	0.61	3	0.59	2.9	0.58	2.9
Chloromethane	0.5 U	1 U	0.59	1.2	0.53	1.1
Trichlorofluoromethane	0.26	1.5	0.26	1.5	0.33	1.9
Methylene Chloride	0.5 U	1.7 U	0.5 U	1.7 U	5.7	20
Chloroform	0.2 U	0.98 U	0.2 U	0.98 U	0.2 U	0.98 U
Carbon Tetrachloride	0.2 U	1.3 U	0.2 U	1.3 U	0.2 U	1.3 U
Trichloroethene	0.2 U	1.1 U	0.2 U	1.1 U	0.2	1.1
1,2-Dichloropropane	0.2 U	0.92 U	0.2 U	0.92 U	0.46	2.1
Toluene	0.2 U	0.75 U	0.2 U	0.75 U	6.3	24
Xylene (<i>m</i> -, <i>p</i> -)	0.2 U	0.87 U	0.2 U	0.87 U	0.27	1.2
Styrene	0.2 U	0.85 U	0.2 U	0.85 U	0.21	0.89
Acetone	5 U	12 U	12	29	16	38
Cuclohexane	0.2 U	0.69 U	0.2 U	0.69 U	0.54	1.9
Methyl Ethyl Ketone	0.54	1.6	1.1	3.2	3	8.8
<i>n</i> -Hexane	0.2 U	0.7 U	0.2 U	0.7 U	3.5	12
Xylene (total)	0.2 U	0.87 U	0.2 U	0.87 U	0.28	1.2

^a Qualifier U indicates that the contaminant was not detected at indicated reporting limit.



FIGURE 2.1 Locations of groundwater and surface water samples collected for volatile organic analyses during the July 2005 baseline sampling event. Source of photograph: NAIP (2003).

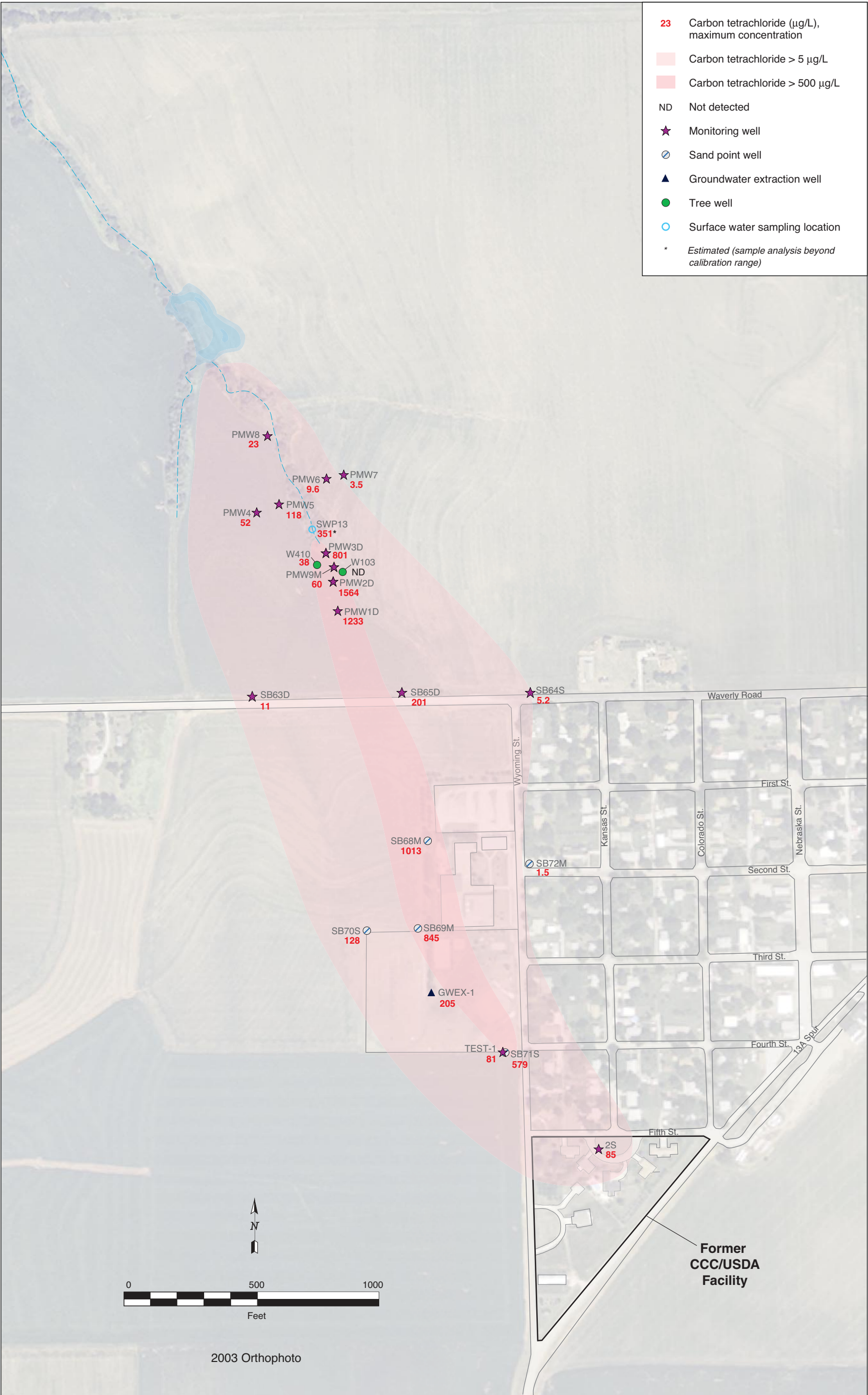


FIGURE 2.2 Results of analyses for carbon tetrachloride (maximum values) in water samples collected during the July 2005 baseline sampling event. Source of photograph: NAIP (2003).

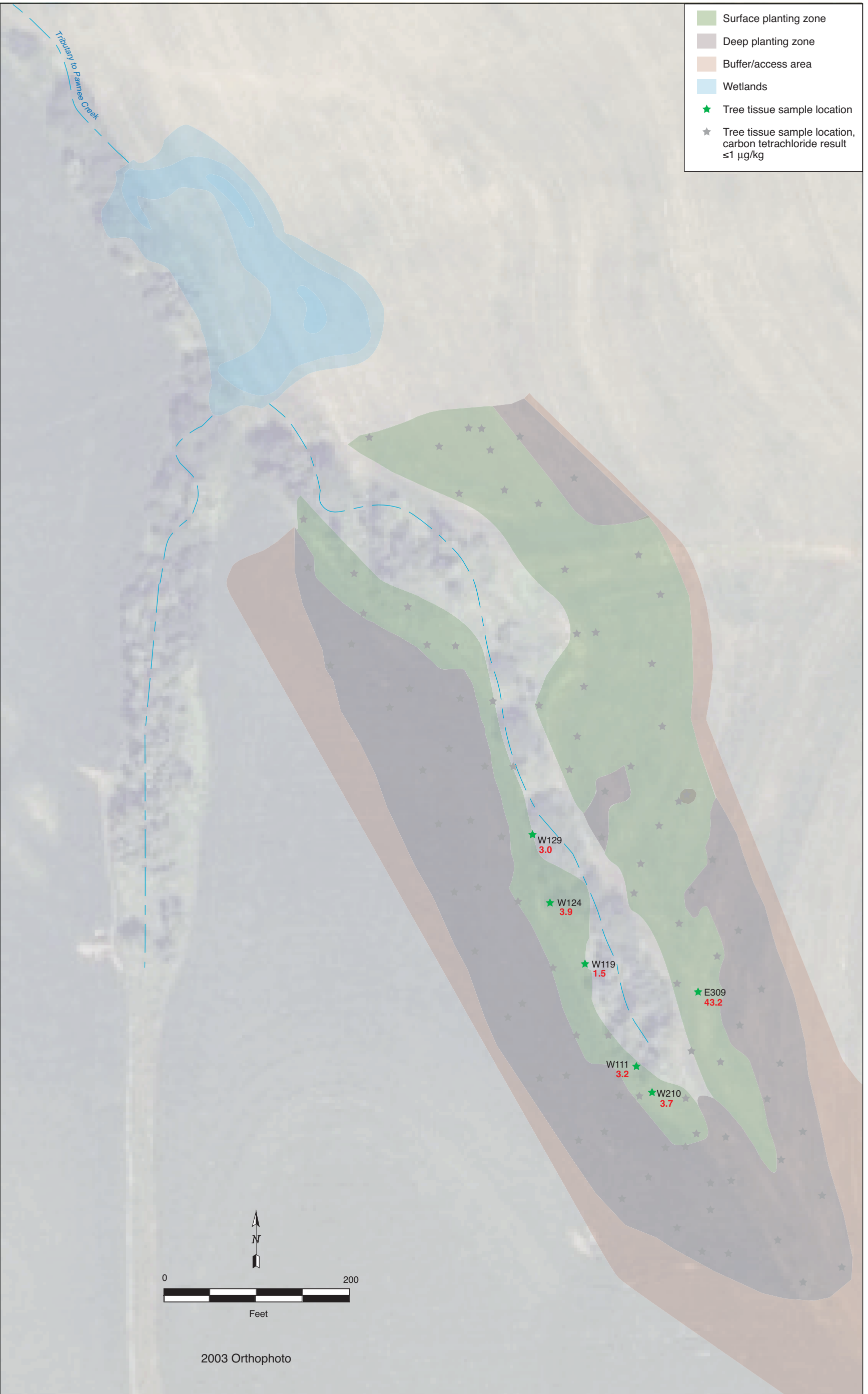


FIGURE 2.3 Results of analyses for carbon tetrachloride (maximum values) in vegetation samples collected in the surface and deep phytoremediation planting zones during the July 2005 baseline sampling event. Source of photograph: NAIP (2003).

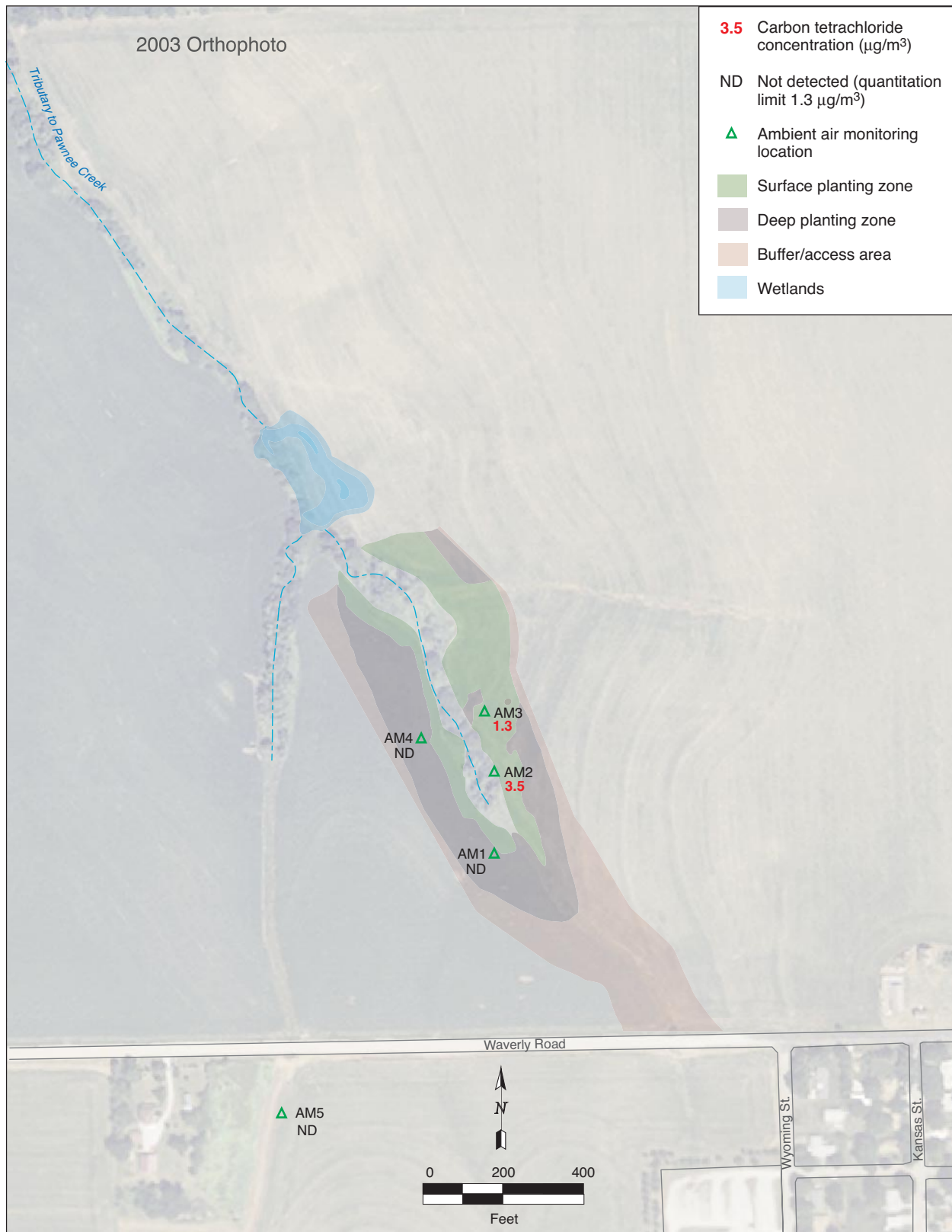


FIGURE 2.4 Results of analyses for carbon tetrachloride (maximum values) in ambient air samples collected during the July 2005 baseline sampling event. Source of photograph: NAIP (2003).

3 Recommended Monitoring Programs

Restoration of the groundwater and surface waters at Murdock is expected to occur over a period of approximately 30 yr or more under the selected removal action described in Section 1 (Argonne 2005b). An initial period of approximately 5 yr is expected to be required for the vegetation introduced in the phytoremediation plantings and constructed wetlands to reach maturity and hence to attain full design capabilities for the uptake and removal of carbon tetrachloride from groundwater and surface water. During this initial period, the remedial effectiveness of the combined treatment systems is therefore expected to increase progressively.

This section outlines two phases of sampling and monitoring of groundwater, surface water, and remedial systems recommended for the Murdock site. During each phase, the monitoring efforts are targeted to address the following specific goals, in keeping with the technical objectives of the removal action outlined in Section 1.1:

- To verify and document the performance of the remediation systems.
- To monitor the migration of the remaining carbon tetrachloride contamination and evaluate the progress of the site restoration.
- To ensure the protection of human health and the environment.

The sampling and monitoring activities proposed here were developed to provide technically defensible data of the type and quantity that are generally consistent with removal actions regulated by the EPA (under CERCLA) or by the Nebraska Department of Environmental Quality (NDEQ), and that are in keeping with the applicable or relevant and appropriate requirements identified for the Murdock site in Appendix A of the EE/CA (Argonne 2005b).

3.1 Initial (Five-Year) Sampling and Monitoring

Approximately 5 yr may be required for the phytoremediation and constructed wetlands components of the Murdock remedial systems to attain their full groundwater and surface water treatment capacity. During this period, the seasonal patterns of groundwater extraction, spray irrigation treatment, and use by the Elmwood-Murdock Public Schools will also be generally

established. Relatively intense sampling and monitoring are therefore proposed to evaluate and document the performance of these systems for treatment of the carbon tetrachloride contamination. Additional sampling is recommended to assess the progress of the combined treatment efforts in reducing carbon tetrachloride concentrations in the groundwater and surface waters at Murdock. The activities proposed for implementation during the initial (5-yr) period of monitoring at the site are summarized in Table 3.1.

3.1.1 Monitoring of the Spray Irrigation Treatment System (Groundwater)

With the approval of the EPA and the NDEQ, GWEX-1 and the associated spray irrigation treatment unit at Murdock are to be operated seasonally, at the discretion of the Elmwood-Murdock Public School system, for the irrigation of school property. The operations are to be performed in accord with a statement of discharge requirements issued by the NDEQ for these facilities (NPDES Tracking No. NE0137464; Appendix B).

In keeping with the NDEQ requirements, samples of the treated groundwater sprayed from the irrigation unit will be collected quarterly during periods of active use and analyzed for carbon tetrachloride, chloroform, and pH levels. Procedures to be used for sampling and analyzing the discharged spray were previously documented (Argonne 2000, 2004). These procedures are in use at Utica, Nebraska, and are accepted by the NDEQ. The results of the analyses are to be reported quarterly. Coincident with each spray sampling event, samples of the untreated groundwater supplied to the treatment unit will also be collected and analyzed for VOCs to enable determination of the carbon tetrachloride removal efficiency of the spray irrigation unit.

Cumulative groundwater production from GWEX-1 will be recorded by using a totalizing flow meter. The results will be used in conjunction with the groundwater and spray analysis data to estimate the quantities of carbon tetrachloride (and chloroform) removed from the aquifer by GWEX-1 and treated by the spray irrigation unit.

The NDEQ has identified the outfall from the spray irrigation unit as a land application (Appendix B). No specific target concentrations for the removal of carbon tetrachloride (or chloroform) by the spray irrigation treatment unit at Murdock are therefore established in the NDEQ's discharge requirements; only the actual concentrations discharged to the surface need to

TABLE 3.1 Monitoring plan for the Murdock removal action.

	Measurement Parameter and Frequency in Initial Five Years of Monitoring ^a							Long-Term Measurement Parameter and Frequency ^a				
		Quarterly		Twice Yearly		End of Five Years		Quarterly		Annual		Every Five Years
Location	Continuous Automated Water Level	Manual Water Level	VOCs in GW(Sp), SW	VOCs in Air, GW(Ph), GW(Pl), Veg	Geochem in GW(Ph) ^b	VOCs in GW(Ph), GW(Pl)		Manual Water Level	VOCs in GW(Sp), SW	VOCs in GW(Ph), Veg	Geochem in GW(Ph) ^b	VOCs in GW(Ph), GW(Pl)
Extraction-Spray Irrigation System (Groundwater)												
GWEX-1			x ^c			x			x			
Spray Unit Discharge			x ^c						x			
Phytoremediation Treatment Area (Vegetation)												
Figure 3.2 ^d				x						x		x
Phytoremediation Treatment Area (Groundwater)												
PMW1S	x			x		x		x		x		x
PMW1D	x			x		x		x		x		x
PMW2SA	x			x	x	x		x		x	x ^e	x
PMW2D	x			x	x	x		x		x	x ^e	x
PMW3S	x			x	x	x		x		x	x ^e	x
PMW3D	x			x	x	x		x		x	x ^e	x
PMW4	x			x		x		x		x		x
PMW5	x			x	x	x		x		x	x ^e	x
PMW6	x			x	x	x		x		x	x ^e	x
PMW7	x			x		x		x		x		x
PMW8	x			x	x	x		x		x	x ^e	x
PMW9S	x			x	x	x		x		x	x ^e	x
PMW9M				x		x				x		x
PMW9D	x			x	x	x		x		x	x ^e	x
W103				x	x	x				x	x ^e	x
W410				x	x	x				x	x ^e	x
Phytoremediation and Wetlands Treatment Areas (Surface Water)												
SWM1			x						x			
SWM2			x						x			
SWM3 ^f			x						x			
Phytoremediation and Wetlands Treatment Areas (Ambient Air) ^g												
AA1				x						x ^e		
AA2				x						x ^e		
AA3				x						x ^e		
BA1				x						x ^e		
Upgradient Plume Area (Groundwater)												
1S, 1D		x				x		x				x ^j
2S, 2D	x ^h	x ⁱ		x		x		x		x ^j		x ^j
3S, 3D		x				x		x				x ^j
4S, 4D		x				x		x				x ^j
MW06		x				x		x				x ^j
TEST-1		x		x		x		x		x ^j		x ^j
WP49 ^k	x	x						x				
WP51D ^k		x						x				
WP54 ^k		x						x				
SB63S, SB63D		x				x		x				x ^j
SB64S, SB64M, SB64D		x				x		x				x ^j
SB65S, SB65D	x ^h	x ⁱ		x		x		x		x ^j		x ^j
SB68S, SB68M, SB68D				x		x				x ^j		x ^j
SB69M, SB69D						x						x ^j
SB70S, SB70M, SB70D						x						x ^j
SB71S, SB71M, SB71D				x		x				x ^j		x ^j
SB72S, SB72M, SB72D						x						x ^j

^a Abbreviations: Geochem, geochemistry; GW(Ph), groundwater in phytoremediation area; GW(Pl), groundwater in upgradient plume area; GW(Sp), groundwater in extraction well–spray irrigation system; SW, surface water; Veg, vegetation; VOCs, volatile organic compounds.

^b Measurements will include dissolved oxygen, redox potential, and concentrations of Fe²⁺ and breakdown products. Additional parameters will be included if required (see Section 3.1.2).

^c Additional measurements will include pH, volume produced, and volume discharged.

^d Initial sampling will be in early spring and early fall, at locations depicted in Figure 3.2. Long-term sampling will be in early fall, at selected locations to be determined.

^e Measurements are subject to verification of need during the initial 5-yr monitoring period.

^f SWM3 is recommended as the compliance point for overall system discharge. The recommended compliance level is a carbon tetrachloride concentration of 44.2 µg/L in surface water.

^g Ambient air sampling will occur in early spring and near the peak of the vegetation growth cycle. Background location BA1 is southwest and upgradient/upstream of the tributary headwaters area.

^h Data logger will be in the deep well at this location.

ⁱ Manual measurements will be made in the shallow well at this location.

^j Locations are subject to change as the configuration of the groundwater plume evolves over time.

^k Critical temporary piezometers for water level monitoring; permission to retain these piezometers is being requested.

be reported. The NDEQ document qualitatively notes, however, that the discharge may not be toxic to aquatic life in surface waters of the state outside the mixing zones allowed in NDEQ Title 117 — *Nebraska Surface Water Quality Standard*. This standard defines a carbon tetrachloride concentration of 44.2 µg/L as the maximum acceptable level for the chronic exposure of aquatic life in surface waters. A maximum target concentration of 44.2 µg/L is therefore proposed as the quantitative evaluation criterion for assessment of the spray irrigation treatment system's performance at Murdock.

3.1.2 Monitoring of the Phytoremediation Treatment System (Groundwater)

Carbon tetrachloride removal from the Murdock aquifer within the phytoremediation treatment area is expected to occur through the combined effects of

- Hydraulic “pumping” of the contaminated groundwater as a result of plant uptake,
- Transpiration and degradation of carbon tetrachloride within plant tissues, and
- Enhanced microbial degradation (reductive dechlorination) in the root zone created by the plants.

The effectiveness of each of these removal processes is expected to increase as the phytoremediation plantings approach maturity.

Evidence of Hydraulic “Pumping” Effects. To monitor for direct evidence of hydraulic “pumping” effects in the phytoremediation area during the developmental period, a water level measuring network of 16 observation points with automated water level recorders is proposed (Figure 3.1 and Table 3.1). The recorders will be programmed to collect measurements at a relatively high frequency (approximately hourly) and will be downloaded quarterly to permit analysis of the accumulated data. The automated monitoring will facilitate the detection of potential diurnal or seasonal fluctuations in groundwater levels associated with cyclic use of water by the plants, as well as potential longer-term, cumulative trends in depression of the local groundwater levels over time. The results, together with data collected from the weather station on the site, will serve as the basis for quantitative estimation of groundwater withdrawal rates by the phytoremediation plantings.

To further document the patterns of groundwater flow into the phytoremediation treatment area, the automated water level readings will be supplemented by quarterly manual measurements at additional permanent observation points across the Murdock site (Table 3.1 and Appendix A).

Evidence of Carbon Tetrachloride Removal. To verify the removal of carbon tetrachloride from groundwater by the phytoremediation plantings, a program of vegetation sampling and analysis for VOCs is proposed. Samples of plant tissues (primarily leaf and stem materials) will be collected from selected tree locations on an approximate grid pattern (Figure 3.2) designed for representative coverage of both the surface and deep planting areas and also the range of species (see Section 1.2) installed at the site. The data will provide a quantitative, comparative basis for the evaluation of contaminant uptake by the plantings in relation to the initial vegetation sampling results presented in Section 2.3.

In light of the seasonal growth cycles associated with the phytoremediation plantings, sampling of the vegetation at approximately six-month intervals is proposed during the initial (5-yr) monitoring period: (1) in early spring, before the onset of significant plant growth, and (2) in late summer or early fall, near the end of the growing cycle. Such sampling will minimize sampling effort and costs but will effectively document the temporal patterns and net annual effects of carbon tetrachloride uptake and elimination by the phytoremediation system. Supplemental vegetation sampling may also be conducted at selected times and locations during the initial monitoring period to document the effects of specific climatic or other environmental factors on the uptake of carbon tetrachloride by the plantings. The proposed vegetation sampling will coincide (whenever possible) with GWEX-1 and spray treatment sampling described in Section 3.1.1 and with the groundwater, surface water, and air sampling activities described in Sections 3.1.3–3.1.5 (Table 3.1).

Evidence of Enhanced Microbial Degradation. Though microbial activity within the root zone created by the phytoremediation plantings is expected to augment the removal of carbon tetrachloride from the groundwater, direct measurement of the microbial activity at regular intervals is neither easy nor economical.

As a logistically viable alternative, a program of geochemical sampling and analysis of the groundwater within the phytoremediation area is proposed to monitor the anticipated development of the reducing/anaerobic conditions required for the microbial degradation of carbon tetrachloride by reductive dechlorination. This monitoring will include measurements of

dissolved oxygen content, oxidation-reduction potential, and reduced iron (Fe^{2+}) levels at the locations listed in Table 3.1 and shown in Figure 3.3, in conjunction with direct analyses for possible dechlorination daughter products (chloroform, dichloromethane [methylene chloride], etc.).

If the development of reducing/anaerobic conditions is demonstrated and elevated levels of daughter products are identified, additional geochemical indicators of anaerobic microbial activity, including dissolved methane and carbon dioxide levels, nitrate/nitrite ratios, and sulfate/sulfide ratios, will also be determined. Sampling and analyses for these additional parameters will also be performed in conjunction with the sampling activities described in Sections 3.1.3–3.1.5 (Table 3.1).

3.1.3 Monitoring of the Surface Water Treatment Systems

Carbon tetrachloride levels in the surface waters of the tributary creek are expected to decrease through the effects of multiple processes, including

- Contaminant removal from the influent groundwater as a result of upgradient extraction by GWEX-1 and treatment in the phytoremediation area;
- Phytoremediation and microbial degradation at and near the surface, in the phytoremediation and wetlands treatment areas; and
- Direct evaporation, plus mixing and dilution with uncontaminated precipitation and runoff, in the phytoremediation and wetlands treatment areas.

The combined effects of these processes will determine the level of carbon tetrachloride removal achieved in the effluent surface waters released from the treatment areas to the downstream reaches of the tributary creek and hence to Pawnee Creek. To quantitatively evaluate the effectiveness of the processes, surface water sampling for VOCs analyses is recommended at three critical locations along the tributary creek, as shown in Figure 3.4 (also Table 3.1).

Sampling point SWM1, which coincides with the surface water sampling location previously designated SWP13, lies near the upgradient edge of the phytoremediation treatment area. As noted in Section 2.2, past sampling at this location consistently demonstrated the highest levels of carbon tetrachloride detected in surface waters; these levels may therefore be indicative of the maximum concentrations in groundwater seepage to the headwaters of the tributary creek.

Proposed sampling point SWM2 lies directly downstream of the phytoremediation planting area (and upstream of the wetlands) and is intended to monitor the reduction in carbon tetrachloride levels achieved in the phytoremediation treatment zone.

Sampling point SWM3 lies directly downstream of the outfall from the wetlands treatment zone, and hence it will reflect the final contaminant levels achieved in effluent from the combined treatment processes. *Location SWM3 should be considered the primary point for quantitative assessment of the net performance of the Murdock treatment efforts*, in terms of achieving carbon tetrachloride concentrations in the surface waters of the tributary creek that meet regulatory requirements for the protection of human health and the environment. A maximum target concentration of 44.2 µg/L should be adopted for this discharge, as established by the NDEQ for surface waters under NDEQ Title 117 — *Nebraska Surface Water Quality Standard*.

Quarterly sampling for VOCs is recommended at locations SWM1–SWM3. Sampling at these points (for two of the events each year) will be timed to coincide with the sampling activities described in Sections 3.1.2, 3.1.4, and 3.1.5 (Table 3.1).

3.1.4 Monitoring of Contaminant Reduction in the Groundwater Plume

Contaminant reduction in the groundwater carbon tetrachloride plume is expected to occur through the effects of multiple processes, including

- Contaminant removal as a result of upgradient extraction by GWEX-1 and downgradient treatment within the phytoremediation area; and
- Evaporation, mixing, dilution, and dispersion of carbon tetrachloride along the groundwater migration pathway.

To determine the impact of the removal action efforts on carbon tetrachloride levels in the plume, twice yearly groundwater sampling for VOCs analyses is recommended (during the initial 5-yr period) at selected points along the approximate central axis of the groundwater plume, as well as within the phytoremediation area (Figure 3.5 and Table 3.1). Past sampling demonstrated that the concentrations detected at these locations typically reflect the maximum carbon tetrachloride levels identified in groundwater along the plume migration pathway. Sampling at these points will be performed in conjunction with the sampling activities described in Sections 3.1.2, 3.1.3, and 3.1.5 (Table 3.1).

At the end of the initial 5-yr monitoring period, groundwater sampling for VOCs analyses is recommended in the full suite of permanent observation points listed in Table 3.1, to permit another delineation of the plume in keeping with the past sampling efforts at this site (documented in Figures 2.9 and 2.10 of the Murdock EE/CA [Argonne 2005b]).

3.1.5 Monitoring of Local Atmospheric Carbon Tetrachloride Levels

Atmospheric sampling and analyses for VOCs conducted as part of the Murdock baseline studies identified little or no contamination of the ambient atmosphere by carbon tetrachloride (or chloroform) in the vicinity of the tributary creek headwaters (Section 2.4), despite the documented uptake of carbon tetrachloride by the natural vegetation in this area (Argonne 2005b). The release of carbon tetrachloride to the atmosphere is expected to increase in the phytoremediation and wetlands treatment areas, however, as these areas mature. Throughout the course of the removal action, these treatment areas will remain open to the public for recreational access and to workers for the required sampling, monitoring, and maintenance activities.

To ensure that potential human exposure levels remain within acceptable levels in the treatment areas, a program of atmospheric sampling and analysis for VOCs is recommended. Sampling twice per year (once in early spring, prior to the onset of significant plant growth, and once near the peak of the seasonal growing cycle) is proposed at four locations (Figure 3.6 and Table 3.1). Air sampling locations AA1–AA3 are in the shallow and deep planting areas in the phytoremediation treatment zone and adjacent to the constructed wetlands, along the public walking paths. A fourth air sampling location (BA1) is at the “background” location sampled during the baseline studies (AM5 in the former terminology; Section 2.4). Sampling at BA1 will identify potential changes in atmospheric contaminant levels at Murdock that are unrelated to the

groundwater and surface water restoration activities near the tributary headwaters. The air samples will be collected and analyzed by using the procedures described in Section 2.4.

No enforceable regulatory criteria have been promulgated for the evaluation of carbon tetrachloride contamination in ambient outdoor air in non-occupational settings. Many guidance values have been developed, however, as maximum acceptable contaminant levels for inhalation under a variety of exposure scenarios. The Agency for Toxic Substances and Disease Registry's intermediate inhalation minimal risk level of $192 \mu\text{g}/\text{m}^3$ (<http://www.atsdr.cdc.gov/toxprofiles/tp30-c2.pdf>) is recommended as a conservative target concentration for ambient outdoor air sampling results. This target concentration is considered to be protective against both cancer and non-cancer health effects for workers and visitors in the treatment areas near the creek (EPA 2005).

3.1.6 Reporting of the Monitoring Results

The following reporting schedule is recommended:

- *Quarterly* reporting of analytical results for the spray irrigation treatment system monitoring (Section 3.1.1) to the appropriate regulatory agencies, in keeping with the discharge requirements specified for this activity (Appendix B).
- *Quarterly* reporting of analytical results for the surface water monitoring (described in Section 3.1.3) to the appropriate regulatory agencies to document the effectiveness of the groundwater and surface water treatment systems.
- *Annual* reporting of the full results of the sampling and monitoring programs (outlined in Sections 3.1.1–3.1.5) for the current year.
- *As requested* by the regulatory agencies, brief (data only) accounts of individual sampling and monitoring activities.

- *At the end of the initial 5-yr monitoring period*, a summary report evaluating the development of the Murdock treatment systems and assessing the performance of the monitoring programs, with a new plume delineation.

The reporting schedule is summarized in Table 3.2.

3.2 Long-Term Sampling and Monitoring

The sampling and monitoring programs outlined in Section 3.1 will be critically evaluated at the end of the initial 5-yr development period to (1) determine anticipated needs for long-term performance monitoring of the Murdock remedial systems and (2) demonstrate the progress of the removal action toward the ultimate restoration of the site. A detailed long-term monitoring program will be recommended at that time. The present expectation is that the specific activities outlined in Section 3.1 will be continued, at the revised sampling frequencies suggested below and summarized in Table 3.1.

3.2.1 Monitoring of the Spray Irrigation Treatment System and Discharge

The spray irrigation treatment system influent groundwater and effluent spray will continue to be sampled for VOCs analyses (and results will be reported) *quarterly*, or on any amended schedule required for compliance with the regulatory discharge requirements (Appendix B) established for these activities.

3.2.2 Monitoring of the Phytoremediation Treatment System

Longer-term monitoring of the phytoremediation treatment system is recommended as follows:

- *Quarterly* manual water level measurements in the network of observation points listed in Table 3.1 and Appendix A to document longer-term trends in groundwater levels.

TABLE 3.2 Reporting schedule for site restoration monitoring activities at Murdock, Nebraska.

Subject of Report	Frequency in Initial Five Years	Frequency after Year Five
Analytical results for spray irrigation system	Quarterly	Quarterly
Analytical results for surface water monitoring	Quarterly	Quarterly
Full results of sampling and monitoring for current year	Annual	Annual
Brief (data only) accounts of individual sampling and monitoring activities	As requested	As requested
Summary evaluation of development and performance, with plume delineation	At end of five years	Does not apply
Full review of monitoring results and evaluation of removal action progress, with plume delineation	Does not apply	Every five years

- *Annual* vegetation sampling, near the end of the growing season, at locations to be selected on the basis of the 5-yr reviews described above and in Section 3.2.6.
- *Annual* sampling of groundwater at selected locations in the phytoremediation treatment area for geochemical analyses to verify the persistence of anaerobic/reducing conditions conducive to the reductive dechlorination of carbon tetrachloride, if the results of the initial (5-yr) monitoring indicated that continued testing is warranted.

3.2.3 Monitoring of the Surface Water Treatment Systems and Discharge

Continued *quarterly* sampling of the surface waters at locations SWM1–SWM3 (Figure 3.4) is recommended, as the primary indicator of the net effectiveness of the groundwater and surface water treatment systems for restoration of the surface waters discharged to the tributary creek.

3.2.4 Monitoring of Contaminant Reduction in the Groundwater Plume

Longer-term groundwater monitoring for VOCs levels is recommended as follows:

- *Annual* groundwater sampling at the selected critical observation points identified in Figure 3.5 and listed in Table 3.1.
- *At 5-yr intervals*, groundwater sampling for VOCs analyses in the full suite of permanent observation points summarized in Table 3.1 to permit redelineation of the plume.

Modifications to the sampling points identified in Figure 3.5 may be required as the configuration of the residual plume changes over time. Such modifications will be addressed with the regulatory agencies as needed during the removal action.

3.2.5 Monitoring of Local Atmospheric Carbon Tetrachloride Levels

The utility of long-term air quality sampling at the Murdock site will be evaluated at the end of the 5-yr initial monitoring period, in consultation with the regulatory agencies. If continued monitoring is considered necessary, annual sampling for VOCs analyses, near the peak of the seasonal growing cycle, is recommended at the locations in the treatment areas and at the “background” location shown in Figure 3.6.

3.2.6 Reporting of the Monitoring Results

The following reporting schedule is recommended:

- *Quarterly* reporting of the spray irrigation treatment system sampling and analysis results for VOCs (subject to the NDEQ discharge requirements in Appendix B), as well as the results of the surface water sampling and analyses, to document the ongoing effectiveness of the treatment systems and to meet regulatory requirements.

- *Annual* reporting of the full results of the sampling and monitoring programs outlined in Sections 3.2.1–3.2.5 during the current year.
- *Every 5 yr*, full review of the monitoring results and an evaluation of the progress of the removal action toward restoration of the Murdock site, in conjunction with the plume delineation sampling proposed in Section 3.2.4.

The reporting schedule is summarized in Table 3.2.

3.3 Summary of Compliance Points and Compliance Values

The following regulatory compliance points and maximum values are recommended for the Murdock treatment systems, on the basis of the discussions in Sections 3.1.1 and 3.1.3:

- *For the groundwater extraction–spray irrigation system*, a compliance level of 44.2 µg/L is recommended for carbon tetrachloride in spray discharge reaching the ground surface. This level is consistent with the qualitative requirements specified for the discharge by the NDEQ (Appendix B), and it reflects the acceptable level for surface waters promulgated under NDEQ Title 117 — *Nebraska Surface Water Quality Standard*. The discharge will be sampled quarterly, and the results will be reported quarterly.
- *For the overall remediation systems*, the compliance level specified under NDEQ Title 117 — *Nebraska Surface Water Quality Standard* is a carbon tetrachloride concentration of 44.2 µg/L in surface water. The recommended compliance point is location SWM3, directly downstream of the outfall from the wetlands treatment zone. Surface water at this location will be sampled quarterly, and the results will be reported quarterly.

3.4 Investigation Methods

The sampling and analysis methods for ambient air are described in Section 2.4, and the method for sampling discharge from the spray irrigation system is cited in Section 3.1.1. Other

investigational activities will be conducted in accordance with procedures defined in the *Master Work Plan* (Argonne 2002).

Quality control requirements will be those defined in the *Master Work Plan* (Argonne 2002), with the added provision that in each sampling event, one sample from each compliance point (Section 3.3) will be analyzed by a reference laboratory using EPA Contract Laboratory Program methodology. The purpose will be additional verification of the results from Argonne's Applied Geosciences and Environmental Management Laboratory, beyond the usual requirement of verification analyses for 10% of water samples.



FIGURE 3.1 Locations proposed for the measurement of groundwater levels through use of automated water level recorders during the initial (five-year) monitoring period. Source of photograph: NAIP (2003).



FIGURE 3.2 Approximate locations proposed for the periodic sampling and analysis of vegetation samples for volatile organic compounds during the initial (five-year) monitoring period. Source of photograph: NAIP (2003).

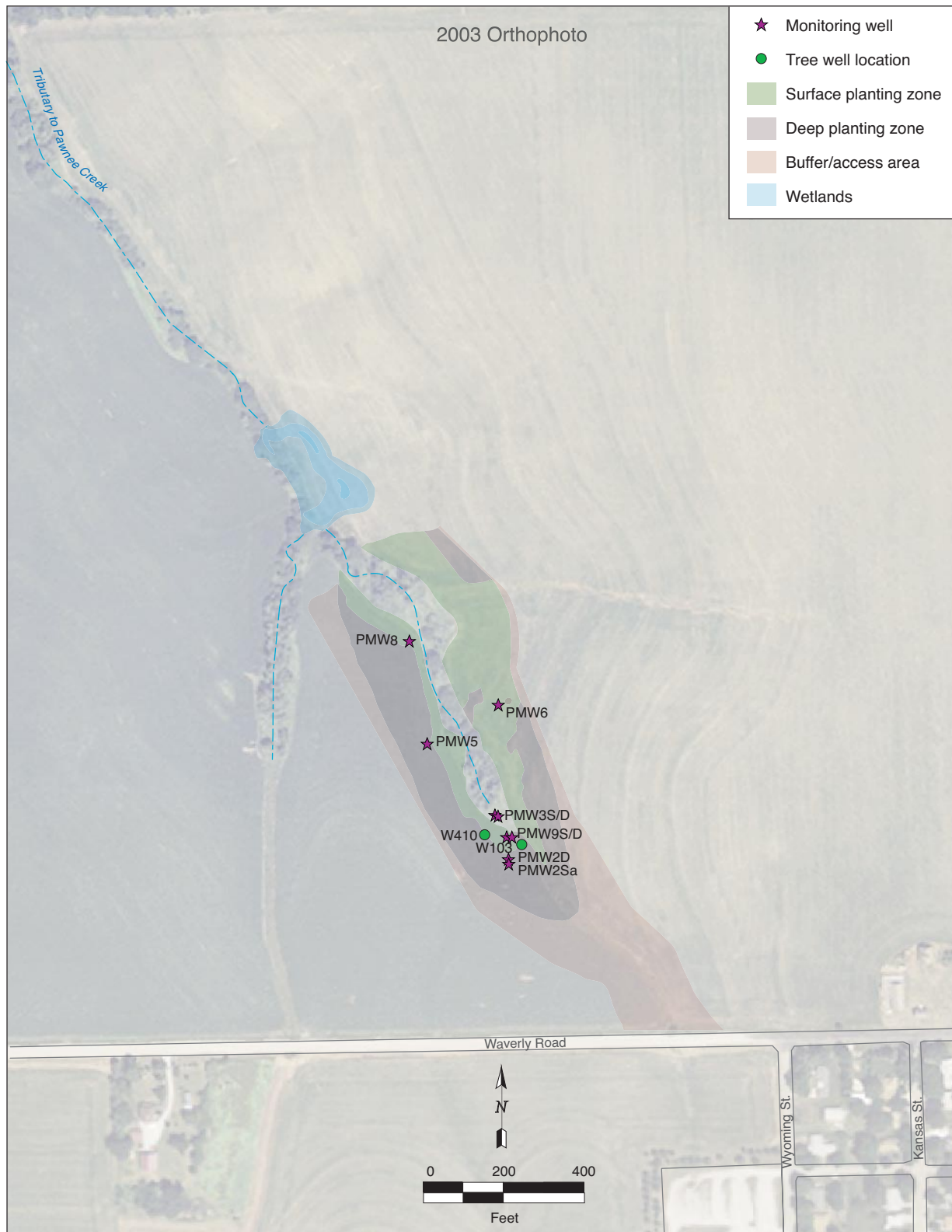


FIGURE 3.3 Locations proposed for the periodic measurement of selected geochemical parameters in groundwater during the initial (five-year) monitoring period, to identify the anticipated development of reducing/anaerobic conditions required for the microbial degradation of carbon tetrachloride by reductive dechlorination. Source of photograph: NAIP (2003).



FIGURE 3.4 Locations proposed for the periodic sampling of surface waters for volatile organic analyses during the initial (five-year) monitoring period. Source of photograph: NAIP (2003).



FIGURE 3.5 Locations proposed for the periodic sampling of groundwater for volatile organic analyses during the initial (five-year) monitoring period. Source of photograph: NAIP (2003).

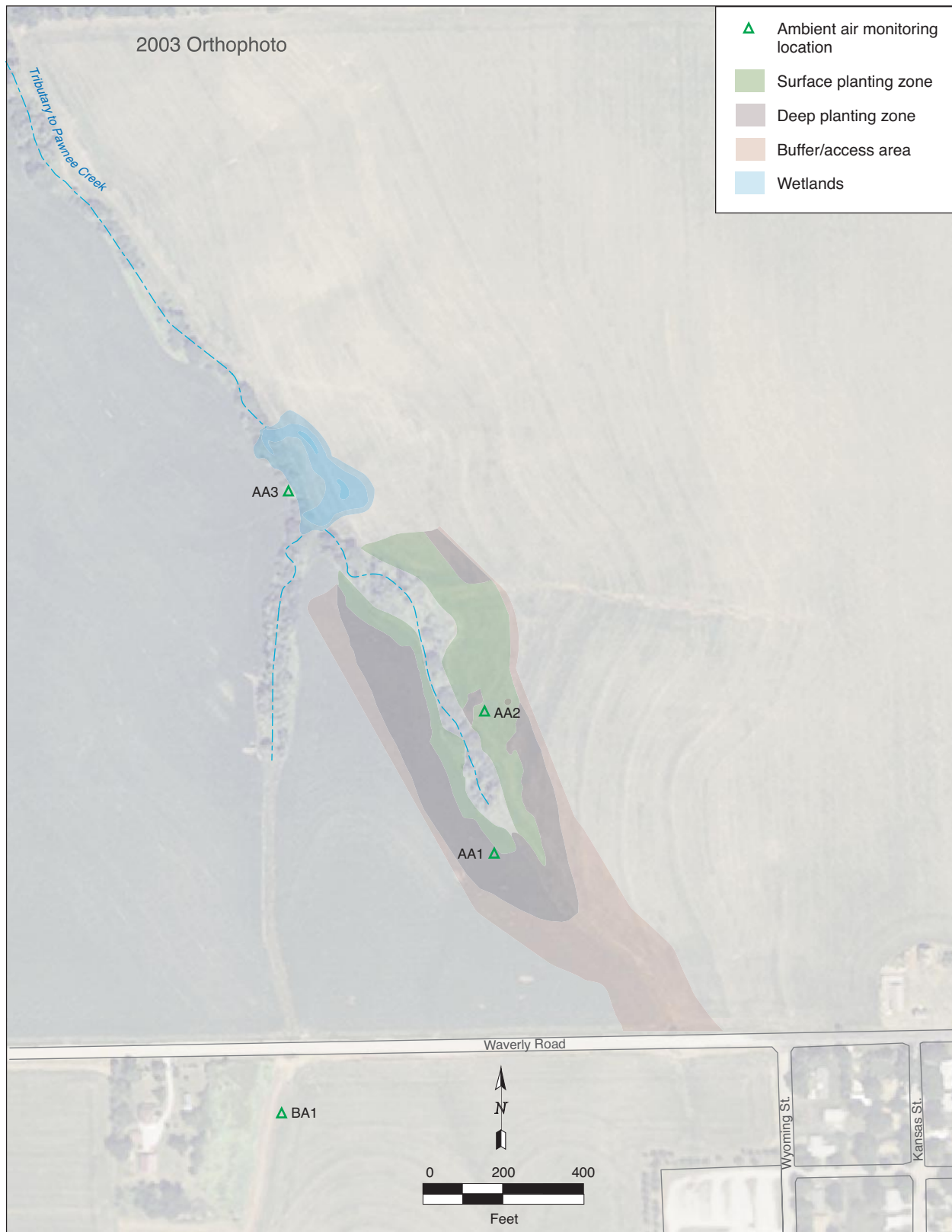


FIGURE 3.6 Locations proposed for the periodic sampling of ambient air for volatile organic analyses during the initial (five-year) monitoring period. Source of photograph: NAIP (2003).

4 References

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Appendix A:

Well Construction Information



FIGURE A.1 Locations of all permanent groundwater observation points at Murdock. Source of photograph: NAIP (2003).

TABLE A.1 Construction data for permanent observation points
at Murdock, Nebraska.

Location	Screen Interval Depth (ft BGL)	Well Depth (ft BGL)	Location	Screen Interval Depth (ft BGL)	Well Depth (ft BGL)
1S	30–40	40	SB69D	62.2–72.2	72.2
1D	85–95	95	SB70S	50.8–58.3	58.3
2S	70.5–80.5	80.5	SB70M	58.4–68.4	68.4
2D	85–95	95	SB71S	53.1–60.6	60.6
3S	64–74	74	SB71M	60.7–70.7	70.7
3D	80–90	90	SB71D	70–80	80
4S	30–40	40	SB72S	49–56.5	56.5
4D	80–90	90	SB72M	59.7–69.7	69.7
MW6	78–83	83	SB72D	70–80	80
WP49 ^a	67–76	76	PMW1S	4.6–14.6	15
WP51D ^a	73–76	76	PMW1D	24.6–34.6	35
WP54 ^a	50–59	59	PMW2SA	4.6–14.6	15
TEST-1	51–81	91	PMW2SB	4.6–14.6	15
GWEX-1	47–77	82	PMW2D	19.6–29.6	30
SB63S	23–38	42	PMW3S	4.5–14.5	15
SB63D	36.5–51.5	53.5	PMW3D	19.5–24.5	25
SB64S	30–50	53	PMW4	19.5–24.5	25
SB64M	48.5–68.5	71.5	PMW5	4.5–14.5	15
SB64D	67–87	89	PMW6	4.5–14.5	15
SB65S	23.7–38.7	40.8	PMW7	14.5–19.5	20
SB65D	38–53	55	PMW8	4.5–14.5	15
SB68S	49–56.5	56.5	PMW9S	5–9	9
SB68M	57.2–67.2	67.2	PMW9M	11–15	15
SB68D	67.8–77.8	77.8	PMW9D	19.5–29.5	32
SB69M	51.9–61.9	61.9			

^a Critical temporary piezometer for water level monitoring; permission to retain this piezometer is being requested.

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January 2004
DNR Form 145

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD _____

1. a. Well Owner's First Name -- Last Name --
b. Company Name USDA CEPD PSA/CCC
c. Correspondent Name -- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104

2. a. Contractor's License No 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com

3. a. Well location: SE ¼ of the SW ¼ of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 367 feet from the (☐ North/☒ South) section line and 2,057 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 Minute 55 Second 46.56
Longitude Degree 96 Minute 17 Second 9.54
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal description) --
f. If for irrigation, the land to be irrigated is -- acres.
g. Well reference letter(s), if applicable: PMW-1S HHSS PWSID _____

4. Permits: None Surface Water Permit Number _____
Management Area Permit Number _____ Industrial Permit Number _____
Geothermal Permit Number _____ Transfer Out-of-State Permit Number _____
Municipal Permit Number _____ Conduct Permit Number _____
Well Spacing Permit Number _____ Other Permit Number _____
HHSS _____ NDEQ _____

5. Purpose of well (Indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with spacing (10-03-01))
☐ Public Water Supply (without spacing) ☐ Recovery ☐ Other _____ (Indicate one)

6. Wells in a Series
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? 15

7. Replacement and abandoned well information
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ (if not registered, date abandoned well was constructed: (month/year))
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (month/year) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (month/year) _____
g. Location of water use of abandoned well: _____

PMW-15 (Cont.)

8. Pump Information

a. Is pump installed at this time? ☐ Yes ☒ No

Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No.

If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____

Pump Installer's Email Address _____

Pump Installer's Firm Name _____

Pump Installer's Firm Address _____

City _____ State _____ Zip _____ Telephone _____

Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____

d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet

f. Pumping equipment installed (mm/dd/yy) _____ g. Pump Brand _____

h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information.

a. Total well depth: 15 feet. b. Static water level: -- feet.

c. Pumping water level: -- feet. d. Well Construction began (mm/dd/yy) 04/29/05

e. Well Construction completed: (mm/dd/yy) 04/29/05 f. Bore hole diameter in inches Top 8 Bottom 8

g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a		b	c	d	e	f	g	h
Placement Depth in Feet		Casing or Screen	Inside Diameter	Outside Diameter	Wall Thickness	Screen Slot Size	Type of Material	Trade Name
From	To							
0	4.6	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
4.6	14.6	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

Placement Depth in Feet		Grout or Gravel Pack	Material Description
From	To		
0	2.25	Bentonite Seal	WyoBen Environplug Bentonite Chips
2.25	15.0	Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

Depth in Feet		Description	Depth in Feet		Description
From	To		From	To	
0	5	orangish brown silty clay with fine sand			
5	11	light tan/gray silty clay with fine sand			
11	13	light tan/gray silty fine sand and clay			
13	15	tan/gray fine sand with silt and clay			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

Water Well Contractor's Signature

Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 145

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD

1. a. Well Owner's First Name -- Last Name --
b. Company Name **USDA CEPD FSA/CCC**
c. Correspondent Name -- Attention **Steve Gilmore**
Address **1400 Independence Avenue, SW**
City **Washington** State **DC** Zip **20250-0513** Telephone **202.720.5104**

2. a. Contractor's License No. **89019** Contractor's Name **Dennis J. Anderson**
Contractor's Email Address **danderson@thielegeotech.com**
b. Drilling Firm Name **Thiele Geotech, Inc.**
Address **13478 Chandler Road**
City **Omaha** State **NE** Zip **68138** Telephone **(402) 556-2171**
Drilling Firm's Email Address **www.thielegeotech.com**

3. a. Well location: **SE** ¼ of the **SW** ¼ of Section **10**, Township **11** North, Range **10E** East/West, **Cass** County.
b. Natural Resources District **Lower Platte South**
c. The well is **361** feet from the (☐ North/☒ South) section line and **2064** feet from the (☐ East/☒ West) section line.
or Latitude Degree **40** Minute **55** Second **46.50**
Longitude Degree **96** Minute **17** Second **9.48**
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal descriptions) --
f. If for irrigation, the land to be irrigated is -- acres.
g. Well reference letter(s), if applicable: **PMW-1D** HHSS PWSID

4. Permits **None** Surface Water Permit Number _____
Management Area Permit Number _____ Industrial Permit Number _____
Geothermal Permit Number _____ Transfer Out-of-State Permit Number _____
Municipal Permit Number _____ Conduct Permit Number _____
Well Spacing Permit Number _____ Other Permit Number _____
HHSS _____ NDEQ _____

5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with spacing (46-638))
☐ Public Water Supply (without spacing) ☐ Recovery ☐ Other _____
(Indicate use)

6. Wells in a Series.
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? **15**

7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (mm/dd/yy) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (mm/dd/yy) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (mm/dd/yy) _____
g. Location of water use of abandoned well: _____

Amw-ID (Cont.)

8. Pump Information

a. Is pump installed at this time? ☐ Yes ☒ No
Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No.
If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____
Pump Installer's Email Address _____
Pump Installer's Firm Name _____
Pump Installer's Firm Address _____
City _____ State _____ Zip _____ Telephone _____
Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____
d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet
f. Pumping equipment installed (mm/dd/yy) _____ g. Pump Brand _____
h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information.

a. Total well depth: 35 feet. b. Static water level: -- feet.
c. Pumping water level: -- feet. d. Well Construction began (mm/dd/yy) 04/29/05
e. Well Construction completed: (mm/dd/yy) 04/29/05 f. Bore hole diameter in inches Top 8 Bottom 8
g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	24.6	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
24.6	34.6	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

Placement Depth in Feet		Grout or Gravel Pack	Material Description
From	To		
0	21.75	Bentonite Seal	WyoBen Environplug Bentonite Chips
21.75	35	Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

Depth in Feet			Description	Depth in Feet			Description
From	To			From	To		
0	5		orangish brown silty clay with fine sand	15	30		light tan silty fine sand and clay
5	11		light tan/gray silty clay with fine sand	30	35		orangish tan silty fine sand and clay
11	13		light tan/gray silty fine sand and clay	35	38		orangish muddy, fine/medium sand
13	15		tan/gray fine sand with silt and clay				

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D. J. Aul 8/24/05 _____
Water Well Contractor's Signature Date Well Owner's Signature Date
If Contractor is unknown or Deceased

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 143

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD

1. a. Well Owner's First Name USDA CRPD PSA/CCC Last Name --
b. Company Name USDA CRPD PSA/CCC
c. Correspondent Name -- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City _____ State _____ Zip _____ Telephone _____

2. a. Contractor's License No. 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com

3. a. Well location: SE ¼ of the SW ¼ of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 446 feet from the (☒ North/☒ South) section line and 2034 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 Minute 55 Second 47.34
Longitude Degree 96 Minute 17 Second 9.84
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal description) --
f. If for irrigation, the land to be irrigated is -- acres.
g. Well reference letter(s), if applicable: PMW-2SA HBSS PWSID --

4. Permits: None Surface Water Permit Number _____
Management Area Permit Number _____ Industrial Permit Number _____
Geothermal Permit Number _____ Transfer Out-of-State Permit Number _____
Municipal Permit Number _____ Conduct Permit Number _____
Well Spacing Permit Number _____ Other Permit Number _____
HBSS NDBQ

5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with casing 40-400)
☐ Public Water Supply (without casing) ☐ Recovery ☐ Other _____ (define on)

6. Wells in a Series
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? 15

7. Replacement and abandoned well information
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (month/year) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (month/year) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (month/year) _____
g. Location of water use of abandoned well: _____

Amw-25A (cont.)

8. Pump Information

a. Is pump installed at this time? ☐ Yes ☒ No

Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No

If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____

Pump Installer's Email Address _____

Pump Installer's Firm Name _____

Pump Installer's Firm Address _____

City _____ State _____ Zip _____ Telephone _____

Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____

d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet

f. Pumping equipment installed (make/model) _____ g. Pump Brand _____

h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information

a. Total well depth: 15 feet b. Static water level: -- feet

c. Pumping water level: -- feet d. Well Construction began (month/year) 04/28/05

e. Well Construction completed: (month/year) 04/28/05 f. Bore hole diameter in inches Top 8 Bottom 8

g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	4.6	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
4.6	14.6	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

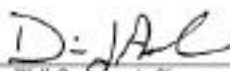
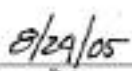
Placement Depth in Feet		Grout or Gravel Pack	Material Description
From	To		
0	2.6	Bentonite Seal	WyoBen Envirompack Bentonite Casing
2.6	15	Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

Depth in Feet		Description	Depth in Feet		Description
From	To		From	To	
0	5	dark brownish orange silty clay			
5	15	light tan/gray fine sand and silt with clay			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

Water Well Contractor's Signature _____ Date 8/29/05 _____
 Well Owner's Signature _____ Date _____
 If Contractor is unknown or Deceased

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 145

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD _____

1. a. Well Owner's First Name USDA CRPD FSA/CCC Last Name ---
b. Company Name USDA CRPD FSA/CCC
c. Correspondent Name --- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104

2. a. Contractor's License No. 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com

3. a. Well location: SE 1/4 of the SW 1/4 of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 433 feet from the (☐ North/☒ South) section line and 2,047 feet from the (☐ East/☒ West) section line.
Longitude Degree 40 Minute 55 Second 47.22
Longitude Degree 96 Minute 17 Second 9.66
d. Street address and subdivision, if applicable ---
Block --- Lot ---
e. Location of water use, if applicable (give legal descriptions) ---
f. If for irrigation, the land to be irrigated is --- acres.
g. Well reference letter(s), if applicable: PMW-2SB HHSS PWSID ---

4. Permits None Surface Water Permit Number _____
Management Area Permit Number _____ Industrial Permit Number _____
Geothermal Permit Number _____ Transfer Out-of-State Permit Number _____
Municipal Permit Number _____ Conduct Permit Number _____
Well Spacing Permit Number _____ Other Permit Number _____
HHSS _____ NDBQ _____

5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with spacing 145-508)
☐ Public Water Supply (without spacing) ☐ Recovery ☐ Other _____ (Indicate use)

6. Wells in a Series.
a. Is this well a part of a series? ☒ Yes, go to part b of this section. ☐ No, go to part 7 of this application.
b. If one or more of the wells in the series is currently registered, give the well registration number ---
c. How many wells in the series are you registering at this time? 15

7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (month/year) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (month/year) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (month/year) _____
g. Location of water use of abandoned well: _____

PMW-256 (Cont.)

8. Pump Information

a. Is pump installed at this time? ☐ Yes ☒ No

Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No.

If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____

Pump Installer's Email Address _____

Pump Installer's Firm Name _____

Pump Installer's Firm Address _____

City _____ State _____ Zip _____ Telephone _____

Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____

d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet

f. Pumping equipment installed (year) _____ g. Pump Brand _____

h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information

a. Total well depth: 15 feet b. Static water level: -- feet

c. Pumping water level: -- feet d. Well Construction began (month/year) 04/29/05

e. Well Construction completed: (month/year) 04/29/05 f. Bore hole diameter in inches Top 8 Bottom 8

g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	4.6	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
4.6	14.6	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

a Placement Depth in Feet		b Grout or Gravel Pack	c Material Description
From	To		
0	2.4	Bentonite Seal	WyoBen Environplug Bentonite Chips
2.4	15	Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

a Depth in Feet		b Description	c Depth in Feet		d Description
From	To		From	To	
0	5	dark brownish orange silty clay			
5	15	light tan/gray fine sand and silt with clay			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D. J. Al
Water Well Contractor's Signature

8/29/05
Date

Well Owner's Signature
If Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 141

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD

1. a. Well Owner's First Name -- Last Name --
b. Company Name USDA CEPD FSA/CCC
c. Correspondent Name -- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104
2. a. Contractor's License No. 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com
3. a. Well location: SE $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 459 feet from the (☐ North/☒ South) section line and 2,034 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 Minute 55 Second 47.46
Longitude Degree 96 Minute 17 Second 9.84
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal descriptions) --
f. If for irrigation, the land to be irrigated is -- acres.
g. Well reference letter(s), if applicable: PMW-2D HHSS PWSID --
4. Permits: None Surface Water Permit Number _____
Management Area Permit Number _____ Industrial Permit Number _____
Geothermal Permit Number _____ Transfer Out-of-State Permit Number _____
Municipal Permit Number _____ Conduct Permit Number _____
Well Spacing Permit Number _____ Other Permit Number _____
HHSS _____ NDBQ _____
5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with spacing 96-000)
☐ Public Water Supply (without spacing) ☐ Recovery ☐ Other _____
(Indicate well)
6. Wells in a Series
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application.
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? 15
7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (mm/dd/yyyy) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (mm/dd/yyyy) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on: (mm/dd/yyyy) _____
g. Location of water use of abandoned well: _____

PMW-2D (Cont.)

8. Pump Information

a. Is pump installed at this time? ☐ Yes ☒ No

Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No.

If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____

Pump Installer's Email Address _____

Pump Installer's Firm Name _____

Pump Installer's Firm Address _____

City _____ State _____ Zip _____ Telephone _____

Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____

d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet

f. Pumping equipment installed (see note) _____ g. Pump Brand _____

h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information

a. Total well depth: 30 feet b. Static water level: _____ feet

c. Pumping water level: _____ feet d. Well Construction began (see note) 04/28/05

e. Well Construction completed: (see note) 04/28/05 f. Bore hole diameter in inches Top 8 Bottom 8

g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	19.6	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
19.6	29.6	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

Placement Depth in Feet		Grout or Gravel Pack	Material Description
From	To		
0	17.6	Bentonite Seal	WyoBen Enviroplug Bentonite Chips
17.6	30	Sand/Gravel Pack	16/20 Washed Silica Sand

12. Geologic Materials Logged

Depth in Feet			Depth in Feet		
From	To	Description	From	To	Description
0	5	dark brownish orange silty clay			
5	20	light tan/gray fine sand and silt with clay			
20	30	light tan/gray fine/medium sand and silt			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D-JAL 8/29/05
Water Well Contractor's Signature Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 145

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD

1. a. Well Owner's First Name -- Last Name --
b. Company Name USDA CEPD FSA/CCC
c. Correspondent Name -- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104
2. a. Contractor's License No. 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com
3. a. Well location: SE $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 581 feet from the (☐ North/☒ South) section line and 2,008 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 Minute 55 Second 48.66
Longitude Degree 96 Minute 17 Second 10.14
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal descriptions) --
f. If for irrigation, the land to be irrigated is -- acres.
g. Well reference letter(s), if applicable: PMW-3S HHSS PWSID -----
4. Permits None Surface Water Permit Number -----
Management Area Permit Number ----- Industrial Permit Number -----
Geothermal Permit Number ----- Transfer Out-of-State Permit Number -----
Municipal Permit Number ----- Conduct Permit Number -----
Well Spacing Permit Number ----- Other Permit Number -----
HHSS ----- NDEQ -----
5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with spacing (46-638))
☐ Public Water Supply (without spacing) ☐ Recovery ☐ Other ----- (indicate use)
6. Wells in a Series.
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? 15
7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well ----- If not registered, date abandoned well was constructed: (mm/dd/yy) -----
c. Replacement well is ----- feet from abandoned well. d. Abandoned well last operated (mm/dd/yy) -----
e. Original well pump column size: ----- inches f. Completion of original well abandonment on (mm/dd/yy) -----
g. Location of water use of abandoned well: -----

PMU-35 (Cont.)

8. Pump Information

a. Is pump installed at this time? ☐ Yes ☒ No
Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No.
If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____
Pump Installer's Email Address _____
Pump Installer's Firm Name _____
Pump Installer's Firm Address _____
City _____ State _____ Zip _____ Telephone _____
Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute Measured _____ Estimated _____
d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet
f. Pumping equipment installed (make/model) _____ g. Pump Brand _____
h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information

a. Total well depth: 15 feet b. Static water level: -- feet
c. Pumping water level: -- feet d. Well Construction began (month/year) 04/25/05
e. Well Construction completed: (month/year) 04/25/05 f. Bore hole diameter in inches Top 8 Bottom 8
g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth In Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	4.5	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
4.5	14.5	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

a Placement Depth in Feet		b Grout or Gravel Pack	c Material Description
From	To		
0	2.4	Bentonite Seal	WyoBen Enviroplug Bentonite Chips
2.4	15	Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

a Depth in Feet			b Depth in Feet		
From	To	Description	From	To	Description
0	5	dark gray silty clay			
5	10	dark brown silty clay			
10	12.5	gray silty clay			
12.5	15	tan fine/medium sand			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D. J. Al
Water Well Contractor's Signature

8/24/05
Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 143

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD

1. a. Well Owner's First Name USDA CEPD FSA/CCC Last Name Steve Gilmore
b. Company Name USDA CEPD FSA/CCC
c. Correspondent Name Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104

2. a. Contractor's License No. 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com

3. a. Well location: SE 1/4 of the SW 1/4 of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 554 feet from the (☐ North/☒ South) section line and 2,001 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 Minute 55 Second 48.42
Longitude Degree 96 Minute 17 Second 10.26
d. Street address and subdivision, if applicable: _____
Block -- Lot --
e. Location of water use, if applicable (give legal descriptions): _____
f. If for irrigation, the land to be irrigated is _____ acres.
g. Well reference letter(s), if applicable: PMW-3D HHSS PWSID

4. Permits: None
Management Area Permit Number _____ Surface Water Permit Number _____
Geothermal Permit Number _____ Industrial Permit Number _____
Municipal Permit Number _____ Transfer Out-of-State Permit Number _____
Well Spacing Permit Number _____ Conduct Permit Number _____
HHSS _____ Other Permit Number _____
NDEQ _____

5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with spacing (15-60 ft))
☐ Public Water Supply (without spacing) ☐ Recovery ☐ Other _____ (indicate use)

6. Wells in a Series:
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application.
b. If one or more of the wells in the series is currently registered, give the well registration number: _____
c. How many wells in the series are you registering at this time? 15

7. Replacement and abandoned well information:
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well: _____ If not registered, date abandoned well was constructed: (mm/dd/yyyy) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (mm/dd/yyyy) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (mm/dd/yyyy) _____
g. Location of water use of abandoned well: _____

Amw-3D (Cont.)

8. Pump Information

- a. Is pump installed at this time? ☐ Yes ☒ No
Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No
If pump installed by pump installer, please fill out license number below.
b. Pump Installer's License No. _____ Pump Installer's Name _____
Pump Installer's Email Address _____
Pump Installer's Firm Name _____
Pump Installer's Firm Address _____
City _____ State _____ Zip _____ Telephone _____
Pump Installer's Firm Email Address _____
c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____
d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet
f. Pumping equipment installed (pump) _____ g. Pump Brand _____
h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information

- a. Total well depth: 30 feet b. Static water level: -- feet
c. Pumping water level: -- feet d. Well Construction began (month/year) 04/25/05
e. Well Construction completed: (month/year) 04/26/05 f. Bore hole diameter in inches Top 8 Bottom 8
g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	19.5	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
19.5	24.5	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

Placement Depth in Feet		Grout or Gravel Pack		Material Description
From	To			
0	17.2		Bentonite Seal	Wyolben Enviroponing Bentonite Chips
17.2	25		Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

Depth in Feet			Depth in Feet		
From	To	Description	From	To	Description
0	5	dark gray silty clay	17	25	gray silty clay with sand
5	10	dark brown silty clay			
10	12.5	gray silty clay			
12.5	17	tan fine/medium sand			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D. J. Al
Water Well Contractor's Signature

8/09/05
Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 145

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD _____

1. a. Well Owner's First Name --- Last Name ---
b. Company Name USDA CEPD FSA/CCC
c. Correspondent Name --- Attention Steve Gilmore
Address 1400 Independence Avenue
City Washington State DC Zip 20250-0513 Telephone 202.720.5104
2. a. Contractor's License No. 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com
3. a. Well location: SE $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 728 feet from the (☐ North/☒ South) section line and 1,762 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 Minute 55 Second 50.16
Longitude Degree 96 Minute 17 Second 13.32
d. Street address and subdivision, if applicable ---
Block --- Lot ---
e. Location of water use, if applicable (give legal descriptions) ---
f. If for irrigation, the land to be irrigated is --- acres.
g. Well reference letter(s), if applicable: PMW-4 HHSS PWSID ---
4. Permits None Surface Water Permit Number _____
Management Area Permit Number _____ Industrial Permit Number _____
Geothermal Permit Number _____ Transfer Out-of-State Permit Number _____
Municipal Permit Number _____ Conduct Permit Number _____
Well Spacing Permit Number _____ Other Permit Number _____
HHSS _____ NDEQ _____
5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with spacing (46-638))
☐ Public Water Supply (without spacing) ☐ Recovery ☐ Other _____
(indicate use)
6. Wells in a Series.
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application
b. If one or more of the wells in the series is currently registered, give the well registration number ---
c. How many wells in the series are you registering at this time? 15
7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (mm/dd/yy) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (mm/dd/yy) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (mm/dd/yy) _____
g. Location of water use of abandoned well: _____

Form-4 (Cont.)

8. Pump Information

a. Is pump installed at this time? ☐ Yes ☒ No
Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No
If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____
Pump Installer's Email Address _____
Pump Installer's Firm Name _____
Pump Installer's Firm Address _____
City _____ State _____ Zip _____ Telephone _____
Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____
d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet
f. Pumping equipment installed (make/model) _____ g. Pump Brand _____
h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information

a. Total well depth: 25 feet. b. Static water level: — feet.
c. Pumping water level: — feet. d. Well Construction began (month/year) 04/26/05
e. Well Construction completed: (month/year) 04/26/05 f. Bore hole diameter in inches Top 8 Bottom 8
g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	19.5	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
19.5	24.5	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

Placement Depth in Feet		Grout or Gravel Pack		Material Description
From	To			
0	17.5		Bentonite Seal	WyoBen Environplug Bentonite Chips
17.5	25		Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

Depth in Feet			Depth in Feet		
From	To	Description	From	To	Description
0	5	dark brown silty clay			
5	13	tan/brown silty sand and clay			
13	20	tan/brown silty clay with sand			
20	25	tan silt and sand			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D. J. AL
Water Well Contractor's Signature

8/29/05
Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94576
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 141

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD _____

1. a. Well Owner's First Name -- Last Name --
b. Company Name USDA CEPD PSA/CCC
c. Correspondent Name -- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104

2. a. Contractor's License No. 89619 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com

3. a. Well location: SE ¼ of the SW ¼ of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 748 feet from the (☐ North/☒ South) section line and 1,847 feet from the (☐ East/☒ West) section line.
or Latitude Degree 49 Minute 55 Second 50.34
Longitude Degree 96 Minute 17 Second 12.24
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal descriptions) --
f. If for irrigation, the land to be irrigated is -- acres
g. Well reference letter(s), if applicable: PMW-5 HBSS PWSID

4. Permits None Surface Water Permit Number _____
Management Area Permit Number _____ Industrial Permit Number _____
Geothermal Permit Number _____ Transfer Out-of-State Permit Number _____
Municipal Permit Number _____ Conduct Permit Number _____
Well Spacing Permit Number _____ Other Permit Number _____
HBSS _____ NDBQ _____

5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with casing 48-60)
☐ Public Water Supply (without casing) ☐ Recovery ☐ Other _____ (define use)

6. Wells in a Series.
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application.
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? 15

7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (mm/yyyy) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (mm/yyyy) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (mm/yyyy) _____
g. Location of water use of abandoned well: _____

Form-5 (Cont.)

8. Pump Information

a. Is pump installed at this time? Yes ☐ No ☒

Is pump installed by well owner in section 17 Yes ☐ No ☐ Is pump installed by contractor in section 27 Yes ☐ No ☐
If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____
Pump Installer's Email Address _____
Pump Installer's Firm Name _____
Pump Installer's Firm Address _____
City _____ State _____ Zip _____ Telephone _____
Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____

d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet

f. Pumping equipment installed (make/model) _____ g. Pump Brand _____

h. This well is designed and constructed to pump less than 50 gpm. Yes ☒ No ☐

9. Well Construction Information

a. Total well depth: 15 feet. b. Static water level: _____ feet.
c. Pumping water level: _____ feet. d. Well Construction began (date) 04/26/05
e. Well Construction completed: (date) 04/26/05 f. Bore hole diameter in inches Top 8 Bottom 8
g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen) - c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	4.5	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
4.5	14.5	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

a Placement Depth in Feet		b Grout or Gravel Pack	c Material Description
From	To		
0	2.5	Bentonite Seal	WyoBen Environment Bentonite Chips
2.5	15	Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

a Depth in Feet			b Depth in Feet		
From	To	Description	From	To	Description
0	5	dark brown silty clay			
		brown/gray fine/medium sand with silt and clay			
5	10				
10	15	tan fine/medium sand with silt and clay			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D. J. A. L.
Water Well Contractor's Signature

8/29/05
Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 145

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD

1. a. Well Owner's First Name -- Last Name --
b. Company Name USDA CEPD FSA/CCC
c. Correspondent Name -- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104

2. a. Contractor's License No 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com

3. a. Well location: SE ¼ of the SW ¼ of Section 10, Township 11 North, Range 10 East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 846 feet from the (☐ North/☒ South) section line and 2,024 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 Minute 55 Second 51.3
Longitude Degree 96 Minute 17 Second 9.9
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal descriptions) --
f. If for irrigation, the land to be irrigated is -- acres.
g. Well reference letter(s), if applicable: PMW-6 HHSS PWSID

4. Permits None Surface Water Permit Number _____
Management Area Permit Number _____ Industrial Permit Number _____
Geothermal Permit Number _____ Transfer Out-of-State Permit Number _____
Municipal Permit Number _____ Conduct Permit Number _____
Well Spacing Permit Number _____ Other Permit Number _____
HHSS _____ NDEQ _____

5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with spacing (46-638))
☐ Public Water Supply (without spacing) ☐ Recovery ☐ Other _____
(indicate use)

6. Wells in a Series.
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? 15

7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (mm/dd/yy) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (mm/dd/yy) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (mm/dd/yy) _____
g. Location of water use of abandoned well: _____

PMW-6 (Cont.)

8. Pump Information

a. Is pump installed at this time? Yes ☐ No ☒

Is pump installed by well owner in section 17 Yes ☐ No ☐ Is pump installed by contractor in section 27 Yes ☐ No ☐

If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____

Pump Installer's Email Address _____

Pump Installer's Firm Name _____

Pump Installer's Firm Address _____

City _____ State _____ Zip _____ Telephone _____

Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute Measured ☐ Estimated ☐

d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet

f. Pumping equipment installed (optional) _____ g. Pump Brand _____

h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information

a. Total well depth: 15 feet b. Static water level: _____ feet

c. Pumping water level: _____ feet d. Well Construction began (mm/dd/yy) 04/25/05

e. Well Construction completed (mm/dd/yy) 04/25/05 f. Bore hole diameter in inches Top 8 Bottom 8

g. Casing and Screen Joints are Welded ☐ Glued ☐ Threaded ☒ Other _____

10. Well Construction (Casing & Screen) a, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	4.5	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
4.5	14.5	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

a Placement Depth in Feet		b Grout or Gravel Pack	c Material Description
From	To		
0	2.5	Bentonite Seal	WyoBen Enviroseal Bentonite Chips
2.5	15	Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

a Depth in Feet			b Depth in Feet		
From	To	Description	From	To	Description
0	12.5	dark grayish brown silty clay			
12.5	15	brown silty clay			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D. J. A. L.
Water Well Contractor's Signature

8/29/05
Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 1978
DNR Form 141

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD

1. a. Well Owner's First Name -- Last Name --
b. Company Name USDA CEPD FSA/CCC
c. Correspondent Name -- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104
2. a. Contractor's License No. 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com
3. a. Well location: SE $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 10, Township 11 North, Range 10E, East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 846 feet from the (☐ North/☒ South) section line and 2,103 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 Minute 55 Second 51.3
Longitude Degree 96 Minute 17 Second 8.88
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal descriptions) --
f. If for irrigation, the land to be irrigated is -- acres.
g. Well reference letter(s), if applicable: PMW-7 HHSS PWSID --
4. Permits None
Management Area Permit Number _____ Surface Water Permit Number _____
Geothermal Permit Number _____ Industrial Permit Number _____
Municipal Permit Number _____ Transfer Out-of-State Permit Number _____
Well Spacing Permit Number _____ Conduct Permit Number _____
HHSS _____ Other Permit Number _____
NDEQ _____
5. Purpose of well (Indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (not spring (41-426))
☐ Public Water Supply (not spring) ☐ Recovery ☐ Other --
(Indicate one)
6. Wells in a Series.
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? 15
7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (mm/dd/yyyy) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (mm/dd/yyyy) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (mm/dd/yyyy) _____
g. Location of water use of abandoned well: _____

Annex-7 (Card.)

8. Pump Information

a. Is pump installed at this time? ☐ Yes ☒ No
Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No
If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____
Pump Installer's Email Address _____
Pump Installer's Firm Name _____
Pump Installer's Firm Address _____
City _____ State _____ Zip _____ Telephone _____
Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute Measured _____ Estimated _____
d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet
f. Pumping equipment installed (make) _____ g. Pump Brand _____
h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information

a. Total well depth: 20 _____ feet b. Static water level: _____ feet
c. Pumping water level: _____ feet d. Well Construction began (month) 05/25/05
e. Well Construction completed: (month) 05/25/05 f. Bore hole diameter in inches Top 8 Bottom 8
g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	14.5	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
14.5	19.5	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

Placement Depth in Feet		Grout or Gravel Pack	Material Description
From	To		
0	12.5	Bentonite Seal	WyoBen Environment Bentonite Chips
12.5	20	Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

Depth in Feet			Depth in Feet		
From	To	Description	From	To	Description
0	10	dark brown silty clay, trace fine sand			
10	15	tan/gray silty clay with fine sand			
15	20	tan/gray silty clay and fine sand			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.


Water Well Contractor's Signature

8/24/05
Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 145

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD

1. a. Well Owner's First Name -- Last Name --
b. Company Name USDA CEPD FSA/CCC
c. Correspondent Name -- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104
2. a. Contractor's License No. 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com
3. a. Well location: SE ¼ of the SW ¼ of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 1,004 feet from the (☐ North/☒ South) section line and 1,814 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 Minute 55 Second 52.86
Longitude Degree 96 Minute 17 Second 12.6
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal descriptions) --
f. If for irrigation, the land to be irrigated is -- acres.
g. Well reference letter(s), if applicable: PMW-8 HHSS PWSID ---
4. Permits None Surface Water Permit Number _____
Management Area Permit Number _____ Industrial Permit Number _____
Geothermal Permit Number _____ Transfer Out-of-State Permit Number _____
Municipal Permit Number _____ Conduct Permit Number _____
Well Spacing Permit Number _____ Other Permit Number _____
HHSS _____ NDEQ _____
5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with spacing (46-638))
☐ Public Water Supply (without spacing) ☐ Recovery ☐ Other _____ (indicate use)
6. Wells in a Series.
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? 15
7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (mm/dd/yy) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (mm/dd/yy) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (mm/dd/yy) _____
g. Location of water use of abandoned well: _____

pmw-8 (Cont.)

8. Pump Information

a. Is pump installed at this time? ☐ Yes ☒ No

Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No.

If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____

Pump Installer's Email Address _____

Pump Installer's Firm Name _____

Pump Installer's Firm Address _____

City _____ State _____ Zip _____ Telephone _____

Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____

d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet

f. Pumping equipment installed (mm/dd/yy) _____ g. Pump Brand _____

h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information.

a. Total well depth: 15 feet. b. Static water level: -- feet.

c. Pumping water level: -- feet. d. Well Construction began (mm/dd/yy) 04/26/05

e. Well Construction completed: (mm/dd/yy) 04/26/05 f. Bore hole diameter in inches Top 8 Bottom 8

g. Casing and Screen Joints are Welded ☐ Glued ☐ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	4.5	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
4.5	14.5	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

Placement Depth in Feet		Grout or Gravel Pack	Material Description
From	To		
0	2.2	Bentonite Seal	WyoBen Environplug Bentonite Chips
2.2	15	Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

Depth in Feet			Description	Depth in Feet			Description
From	To			From	To		
0	10		light gray silty clay				
10	15		gray silty clay with fine sand				

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D: JAL
Water Well Contractor's Signature

8/29/05
Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 145

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD

1. a. Well Owner's First Name -- Last Name --
b. Company Name USDA CEPD FSA/CCC
c. Correspondent Name -- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104
2. a. Contractor's License No 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com
3. a. Well location: SE $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 512 feet from the (☐ North/☒ South) section line and 2,037 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 55 Second 48
Longitude Degree 96 Minute 17 Second 9.78
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal descriptions) --
f. If for irrigation, the land to be irrigated is -- acres.
g. Well reference letter(s), if applicable: PMW-9S HHSS PWSID --
4. Permits None Surface Water Permit Number _____
Management Area Permit Number _____ Industrial Permit Number _____
Geothermal Permit Number _____ Transfer Out-of-State Permit Number _____
Municipal Permit Number _____ Conduct Permit Number _____
Well Spacing Permit Number _____ Other Permit Number _____
HHSS _____ NDEQ _____
5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with spacing (46-638))
☐ Public Water Supply (without spacing) ☐ Recovery ☐ Other _____
(indicate use)
6. Wells in a Series.
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? 15
7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (mm/dd/yy) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (mm/dd/yy) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (mm/dd/yy) _____
g. Location of water use of abandoned well: _____

PMW-95 (Cont.)

8. Pump Information

a. Is pump installed at this time? ☐ Yes ☒ No
Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No
If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____
Pump Installer's Email Address _____
Pump Installer's Firm Name _____
Pump Installer's Firm Address _____
City _____ State _____ Zip _____ Telephone _____
Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____
d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet
f. Pumping equipment installed (make/model) _____ g. Pump Brand _____
h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information

a. Total well depth: 9 _____ feet b. Static water level: _____ feet
c. Pumping water level: _____ feet d. Well Construction began (make/model) 04/28/05
e. Well Construction completed: (make/model) 04/28/05 f. Bore hole diameter in inches Top 8 Bottom 8
g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen) c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	5	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
5	9	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

Placement Depth in Feet		Grout or Gravel Pack	Material Description
From	To		
0	3.5	Bentonite Seal	WyoBen Enviroplug Bentonite Chips
3.5	9	Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

Depth in Feet			Description	Depth in Feet			Description
From	To			From	To		
0	5		dark brown silty clay				
5	9		tan/gray silty clay				

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D. J. Paul
Water Well Contractor's Signature

8/29/05
Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 540

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD

1. a. Well Owner's First Name -- Last Name --
b. Company Name USDA CEPD FSA/CCC
c. Correspondent Name -- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104
2. a. Contractor's License No. 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com
3. a. Well location: SE $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 512 feet from the (☐ North/☒ South) section line and 2,028 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 55 Second 48
Longitude Degree 96 Minute 17 Second 9.9
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal description) --
f. If for irrigation, the land to be irrigated is -- acres.
g. Well reference letter(s), if applicable: PMW-9M HHSS PWSID --
4. Permits None Surface Water Permit Number _____
Management Area Permit Number _____ Industrial Permit Number _____
Geothermal Permit Number _____ Transfer Out-of-State Permit Number _____
Municipal Permit Number _____ Conduct Permit Number _____
Well Spacing Permit Number _____ Other Permit Number _____
HHSS _____ NDEQ _____
5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with testing (44-616))
☐ Public Water Supply (without testing) ☐ Recovery ☐ Other _____ (indicate one)
6. Wells in a Series.
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? 15
7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (month/year) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (month/year) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (month/year) _____
g. Location of water use of abandoned well: _____

Pmw-9m (Cont.)

8. Pump Information

a. Is pump installed at this time? Yes ☐ No ☒

Is pump installed by well owner in section 1? Yes ☐ No ☐ Is pump installed by contractor in section 2? Yes ☐ No ☐
If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____
Pump Installer's Email Address _____
Pump Installer's Firm Name _____
Pump Installer's Firm Address _____
City _____ State _____ Zip _____ Telephone _____
Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____
d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet
f. Pumping equipment installed (mm/dd/yy) _____ g. Pump Brand _____
h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information.

a. Total well depth: 15 feet. b. Static water level: -- feet.
c. Pumping water level: -- feet. d. Well Construction began (mm/dd/yy) 04/28/05
e. Well Construction completed: (mm/dd/yy) 04/28/05 f. Bore hole diameter in inches Top 8 Bottom 8
g. Casing and Screen Joints are Welded ☐ Glued ☐ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	11	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
11	15	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

Placement Depth in Feet		Grout or Gravel Pack	Material Description
From	To		
0	10	Bentonite Seal	WyoBen Environplug Bentonite Chips
10	15	Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

Depth in Feet			Depth in Feet		
From	To	Description	From	To	Description
0	5	dark brown silty clay			
5	10	tan/gray silty clay			
10	15	tan/gray silty clay with sand			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D: JAL
Water Well Contractor's Signature

8/24/05
Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Mail to:
DNR
PO Box 94676
Lincoln, NE 68509-4676
Phone: (402) 471-2363

January 2004
DNR Form 145

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date _____ Sequence No. _____ Registration No. _____
Owner Code No. _____ Receipt No. _____ NRD

1. a. Well Owner's First Name -- Last Name --
b. Company Name USDA CEPD FSA/CCC
c. Correspondent Name -- Attention Steve Gilmore
Address 1400 Independence Avenue, SW
City Washington State DC Zip 20250-0513 Telephone 202.720.5104
2. a. Contractor's License No. 89019 Contractor's Name Dennis J. Anderson
Contractor's Email Address danderson@thielegeotech.com
b. Drilling Firm Name Thiele Geotech, Inc.
Address 13478 Chandler Road
City Omaha State NE Zip 68138 Telephone (402) 556-2171
Drilling Firm's Email Address www.thielegeotech.com
3. a. Well location: SE $\frac{1}{4}$ of the SW $\frac{1}{4}$ of Section 10, Township 11 North, Range 10E East/West, Cass County.
b. Natural Resources District Lower Platte South
c. The well is 512 feet from the (☐ North/☒ South) section line and 2,018 feet from the (☐ East/☒ West) section line.
or Latitude Degree 40 Minute 55 Second 48
Longitude Degree 96 Minute 17 Second 10.02
d. Street address and subdivision, if applicable --
Block -- Lot --
e. Location of water use, if applicable (give legal descriptions) --
f. If for irrigation, the land to be irrigated is -- acres.
g. Well reference letter(s), if applicable: PMW-9D HHSS PWSID _____
4. Permits None
Management Area Permit Number _____ Surface Water Permit Number _____
Geothermal Permit Number _____ Industrial Permit Number _____
Municipal Permit Number _____ Transfer Out-of-State Permit Number _____
Well Spacing Permit Number _____ Conduct Permit Number _____
HHSS _____ Other Permit Number _____
NDEQ _____
5. Purpose of well (indicate one): ☐ Aquaculture ☐ Commercial/Industrial ☐ Dewatering (over 90 days)
☐ Domestic ☐ Ground Heat Exchanger ☐ Groundwater Source Heat Pump ☐ Irrigation ☐ Injection
☐ Livestock ☒ Monitoring ☐ Observation ☐ Public Water Supply (with spacing (46-638))
☐ Public Water Supply (without spacing) ☐ Recovery ☐ Other _____
(indicate use)
6. Wells in a Series.
a. Is this well a part of a series? ☒ Yes; go to part b of this section. ☐ No; go to part 7 of this application
b. If one or more of the wells in the series is currently registered, give the well registration number --
c. How many wells in the series are you registering at this time? 15
7. Replacement and abandoned well information.
a. Is this well a replacement well? ☐ Yes ☒ No
b. Registration number of abandoned well _____ If not registered, date abandoned well was constructed: (mm/dd/yy) _____
c. Replacement well is _____ feet from abandoned well. d. Abandoned well last operated (mm/dd/yy) _____
e. Original well pump column size: _____ inches f. Completion of original well abandonment on (mm/dd/yy) _____
g. Location of water use of abandoned well: _____

pmw-9D (Cont.)

8. Pump Information

a. Is pump installed at this time? ☐ Yes ☒ No

Is pump installed by well owner in section 1? ☐ Yes ☐ No Is pump installed by contractor in section 2? ☐ Yes ☐ No

If pump installed by pump installer, please fill out license number below.

b. Pump Installer's License No. _____ Pump Installer's Name _____

Pump Installer's Email Address _____

Pump Installer's Firm Name _____

Pump Installer's Firm Address _____

City _____ State _____ Zip _____ Telephone _____

Pump Installer's Firm Email Address _____

c. Pumping Rate _____ gallons per minute _____ Measured _____ Estimated _____

d. Drop pipe diameter _____ inches e. Length of drop pipe _____ feet

f. Pumping equipment installed (see note) _____ g. Pump Brand _____

h. This well is designed and constructed to pump less than 50 gpm ☒ Yes ☐ No

9. Well Construction Information

a. Total well depth: 32 feet.

b. Static water level: — feet.

c. Pumping water level: — feet.

d. Well Construction began (see note) 04/27/05

e. Well Construction completed (see note) 04/27/05 f. Bore hole diameter in inches Top 8 Bottom 8

g. Casing and Screen Joints are Welded _____ Glued _____ Threaded ☒ Other _____

10. Well Construction (Casing & Screen)- c, d, e, & g measurements should be in inches to three decimal places

a Placement Depth in Feet		b Casing or Screen	c Inside Diameter	d Outside Diameter	e Wall Thickness	f Screen Slot Size	g Type of Material	h Trade Name
From	To							
0	19.5	Casing	2.00	2.375	0.1875	N/A	PVC	EMI
19.5	29.5	Screen	2.00	2.375	0.1875	0.010	PVC	EMI

11. Grout and Gravel Pack

Placement Depth in Feet		Grout or Gravel Pack		Material Description
From	To			
0	17.6		Bentonite Seal	WyoBen Enviroseal Bentonite Chips
17.6	32		Sand/Gravel Pack	10/20 Washed Silica Sand

12. Geologic Materials Logged

Depth in Feet			Depth in Feet		
From	To	Description	From	To	Description
0	5	dark brown silty clay	23	32	tan, muddy fine/medium sand
5	10	tan/gray silty clay			
10	15	tan/gray silty clay with sand			
15	23	tan clayey sand			

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

D. J. Al
Water Well Contractor's Signature

8/29/05
Date

Well Owner's Signature
if Contractor is unknown or Deceased

Date

Appendix B:

**Nebraska Department of Environmental Quality
Discharge Requirements for the
Murdock Groundwater Treatment System**



Nebraska Department of Environmental Quality

DISCHARGE REQUIREMENTS

For Treatment Ground Water from a Remediation Project
carried out by USDA under the Superfund Regulations

Pursuant to Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), 42 U.S.C. §9601 et seq. and 40 Code of Federal Regulation (CFR) Part 300.400, Title 119, *Rules and Regulations Pertaining to the Issuance of Permits Under the National Pollutant Discharge Elimination System*, constitute applicable requirements for the Murdock Ground Water Treatment System as described on this page. These discharge requirements were developed to meet the substantive requirements that apply to Superfund sites. The Accountable Party identified on this page is responsible for ensuring compliance with the conditions set forth herein.

NPDDES Tracking Number: NE0137464

EIS File Number: 71956-P

Accountable Party: United States Department of Agriculture -- Farm Service Agency

Facility Name: Murdock Ground Water Treatment System

Facility Location: NE¼, NW¼, Section 15, Township 11 North, Range 10 E., Cass County

Also Known as: Fourth and Wyoming Streets, Murdock, Nebraska 68407

Receiving Water: This is a land application using sprinkler system.

Date Prepared: April 4, 2005

Discharge Authorization: This authorization to discharge becomes effective on the date signed and remains in effect until terminated pursuant to the conditions set forth herein.

Pursuant to the Delegation Memorandum dated January 29, 1999 and signed by the Director, the undersigned hereby executes this document on the behalf of the Director.

Signed this _____ day of _____

- Patrick W. Rice
Assistant Director

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This authorization contains discharge limitations, management practices, and requirements for monitoring, record keeping and reporting. See pertinent sections in Parts I, II, III, and Appendix A of this document

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Part III. Other Conditions and Requirements

A. Narrative Limits

Discharges authorized under this permit:

1. Shall not be toxic to aquatic life in surface waters of the State outside the mixing zones allowed in NDEQ Title 117 - *Nebraska Surface Water Quality Standard*;
2. Shall not contain pollutants at concentrations or levels that produce objectionable films, colors, turbidity, deposits, or noxious odors in the receiving stream or waterway;
3. Shall not contain or produce any hydrocarbon sheens; and/or
4. Shall not contain pollutants at concentrations or levels that cause the occurrence of undesirable or nuisance aquatic life in the receiving stream.

B. Additional Monitoring

The Department may require increases in the monitoring frequencies set forth in this permit to address new information concerning a discharge, evidence of potential non-compliance, suspect water quality in a discharge, evidence of water quality impacts in the receiving stream or waterway, or other similar concerns.

C. Modifications

1. The basis for modification are set forth in NDEQ Title 119 - *Rules and Regulations Pertaining to the Issuance of Permits Under the National Pollutant Discharge Elimination System*. This authorization may be modified pursuant to this regulation.

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Appendix A - Standard Conditions that Apply Regulated Discharges

These general conditions are applicable to all regulated discharges under Title 119. These conditions shall not preempt any more stringent requirements found elsewhere in this permit.

A. General Conditions

1. Information Available

All permit applications, fact sheets, permits, discharge data, monitoring reports, and any public comments concerning such shall be available to the public for inspection and copying, unless such information about methods or processes is entitled to protection as trade secrets of the owner or operator under Neb. Rev. Stat. §81-1527, (Cum. Supp. 1992) and Title 115, Chapter 4.

2. Duty to Comply

All authorized discharges shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit.

The permittee shall comply with all conditions of this permit. Failure to comply with these conditions may be grounds for administrative action or enforcement proceedings including injunctive relief and civil or criminal penalties.

The filing of a request by the permittee for a permit modification, revocation and re-issuance, termination or a notification of planned changes or anticipated non-compliance does not stay any permit condition.

3. Duty to Mitigate

The permittee shall take all reasonable steps to minimize, prevent or correct any adverse impact to the environment resulting from noncompliance with this permit, including such accelerated or additional monitoring as required by the NDEQ to determine the nature and impact of the noncompliant discharge.

4. Toxic Pollutants

The permittee shall not discharge pollutants to waters of the State that cause a violation of the standards established in NDEQ Titles 117, 118 or 121. All discharges to surface waters of the State shall be free of toxic (acute or chronic) substances which alone or in combination with other substances, create conditions unsuitable for aquatic life outside the appropriate mixing zone.

5. Oil and Hazardous Substances/Spill Notification

Nothing in this permit shall preclude the initiation of any legal action or relieve the permittee from any responsibilities, liabilities or penalties under Section 311 of the Clean Water Act. The permittee shall conform to the provisions set forth in NDEQ Title 126, *Rules and Regulations Pertaining to the Management of Wastes*. If the permittee knows, or has reason to believe, that oil or hazardous substances were released at the facility and could enter waters of the State or any of the outfall discharges authorized in this permit, the permittee shall immediately notify the Department of a release of oil or hazardous substances. During Department office hours (i.e., 8:00 a.m. to 5:00 p.m., Monday through Friday, except holidays), notification shall be made to the Nebraska Department of Environmental Quality at telephone numbers (402) 471-2186 or (877) 253-2603 (toll free). When NDEQ cannot be contacted, the permittee shall report to the Nebraska State Patrol for referral to the NDEQ Emergency Response Team at telephone number (402) 471-4545. It shall be the permittee's responsibility to maintain current telephone numbers necessary to carry out the notification requirements set forth in this paragraph.

6. Property Rights

The issuance of this permit does not convey any property rights of any sort or any exclusive privileges nor does it authorize any damage to private property or neither any invasion of personal rights nor any infringement of federal, state or local laws or regulations.

7. Other Rules and Regulations Liability

The issuance of this permit in no way relieves the obligation of the permittee to comply with other rules and regulations of the Department.

8. Inspection and Entry

The permittee shall allow the Director or his authorized representative, upon the presentation of his identification and at a reasonable time:

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- a. To enter upon the permittee's premises where a regulated facility or activity is located or conducted, or records are required to be kept under the terms and conditions of the permit,
- b. To have access to and copy any records required to be kept under the terms and conditions of the permit,
- c. To inspect any facilities, equipment (including monitoring and control), practices or operations regulated or required in the permit, and
- d. To sample or monitor any substances or parameters at any location.

B. Management Requirements

1. Duty to Provide Information

The permittee shall furnish to the Department within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit; or to determine compliance with this permit. The permittee shall also furnish to the Department upon request, copies of records retained as a requirement of this permit.

2. Signatory Requirements

All reports and applications required by this permit or submitted to maintain compliance with this permit shall be signed and certified as set forth in this section.

- a. Permit applications shall be signed by a **cognizant official** who meets the following criteria:
 - 1) For a corporation: by a principal executive officer of at least the level of vice-president,
 - 2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively, or
 - 3) For a municipality, state, federal or other public facility: by either a principal executive officer or highest ranking elected official.
- b. Discharge monitoring reports and other information shall be signed by the **cognizant official** or by an **authorized representative**.
- c. An authorized representative is designated by the cognizant official. The authorized representative is responsible for the overall operation of the facility (i.e., a plant manager, a well field operator or a wastewater treatment plant superintendent).
- d. Any change in the signatories shall be submitted to the Department, in writing, within 30 days after the change.
- e. Certification. All applications, reports and information submitted as a requirement of this permit, shall contain the following certification statement:

"I certify, under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations."

C. Monitoring and Records

1. Representative Sampling

Samples and measurements taken as required within this permit shall be representative of the discharge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other waste stream, body of water or substance. Monitoring points shall not be changed without notification to the Department and with the written approval of the Director.

- a. Composite sampling shall be conducted in one of the following manners:
 - 1) Continuous discharge - a minimum of one discrete aliquot collected every three hours,
 - 2) Less than 24 hours - a minimum of hourly discrete aliquots or a continuously drawn sample shall be collected during the discharge, or
 - 3) Batch discharge - a minimum of three discrete aliquots shall be collected during each discharge.

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- b. Composite samples shall be collected in one of the following manners:
 - 1) The volume of each aliquot must be proportional to either the waste stream flow at the time of sampling or the total waste stream flow since collection of the previous aliquot,
 - 2) A number of equal volume aliquots taken at varying time intervals in proportion to flow,
 - 3) A sample continuously collected in proportion to flow, and
 - 4) If it is infeasible or non-representative of the pollutant loadings to conduct flow proportional sampling, the Department may approve the use of time composite samples.
- c. Grab samples shall consist of a single aliquot collected over a time period not exceeding 15 minutes.
 - 1) All sample preservation techniques shall conform to the methods adopted in NDEQ regulations.

2. Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be used to insure the accuracy and reliability of measurements. The accuracy of the measurement devices shall be calibrated and maintained to insure that they are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of +/- 10% from the true discharge rates throughout the range of expected discharge volumes. Guidance in selection, installation, calibration and operation of acceptable flow measurement devices can be obtained from the following references:

- a. "Water Management Manual," U. S. Department of Interior, Bureau of Reclamation, Second Edition, Revised Reprint, 2001, 327 pp. This document is available from the National Technical Information Services (NTIS).
- b. "NPDES Compliance Inspection Manual," U. S. Environmental Protection Agency, Office of Enforcement and Compliance Assurance, Publication EPA 300-B-94-014 September 1994. This document is available from the National Technical Information Services (NTIS).

3. Test Procedures

Test procedures used for monitoring required by this permit, shall conform to the methods adopted in NDEQ regulations.

4. Averaging of Measurements

Averages shall be calculated as an arithmetic mean except:

- a. Bacterial counts which shall be calculated as a geometric mean, or
- b. Where otherwise specified by the Department.

5. Retention of Records

The accountable party shall retain records of all monitoring activities for a period of at least three years) as set forth in NDEQ Titles 119. The types of records that must be retained include, but are not limited to:

- a. Calibration and maintenance records,
- b. Original strip chart recordings,
- c. Copies of all reports required by this permit,
- d. Monitoring records and information, and
- e. Electronically readable data.

6. Record Contents

Records of sampling or monitoring information shall include:

- a. The date(s), exact place, time and methods of sampling or measurements,
- b. The name(s) of the individual(s), who performed the sampling or measurements,
- c. The date(s) the analyses were performed,
- d. The individual(s) who performed the analyses,
- e. The analytical techniques or methods used,
- f. The results of such analyses, and
- g. Laboratory data, bench sheets and other required information.

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D. Reporting Requirements

1. 24-Hour Reporting

The accountable party shall report to the NDEQ, within 24 hours of becoming aware of:

- a. Any noncompliance that may endanger the environment or human health or welfare,
- b. Any unanticipated bypass as set forth in NDEQ Titles 119 and/or 127,
All upsets as set forth in NDEQ Titles 119 and/or 127,
- c. Any discharge to a POTW that causes a violation of the prohibited discharge standards set forth in NDEQ Title 119 or
- d. Any noncompliance of an effluent limitation in this permit.

Initial notification may be verbal. A written noncompliance notification shall be submitted as set forth in Section D 3 of this permit.

2. Written Noncompliance Notification

- a. The accountable party shall submit a written noncompliance report to the NDEQ:
 - 1) Within five days of becoming aware of any noncompliance with the:
 - (a) NPDES toxic pollutant effluent limitations or requirements set forth in this permit.
 - 2) Within seven days of becoming aware of any other noncompliance with the NPDES requirements and/or effluent limitations set forth in this permit.
- b. The written notification shall be submitted on a noncompliance form supplied by the Department and shall include:
 - 1) A description of the discharge and cause of noncompliance,
 - 2) The period of noncompliance, including exact dates and times, or if not corrected, the anticipated time the noncompliance is expected to continue, and
 - 3) The steps taken to reduce, eliminate, and prevent the reoccurrence of the noncompliance.

The submittal of a written noncompliance report does not relieve the permittee of any liability from enforcement proceedings that may result from the violation of permit or regulatory requirements.

3. Quarterly Discharge Monitoring Reports (DMRs)

The permittee shall report the monitoring results required by this permit on a DMR form supplied or approved by the Department. Monitoring results shall be submitted on a quarterly basis using the reporting schedule set forth below, unless otherwise specified in this permit or by the Department.

<u>Monitoring Quarters</u>	<u>DMR Reporting Deadlines</u>
January - March	April 28
April - June	July 28
July - September	October 28
October - December	January 28

If the permittee monitors any pollutant more frequently than required by this permit, using procedures specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted on the DMR. The frequency of the analysis shall also be reported on the DMR.

4. Changes in Discharge

Any facility expansion, production increases or process modifications which will result in new or substantially increased discharges of pollutants or a change in the nature of the discharge of pollutants must be reported by the permittee 180 days prior to the expansion, increases or modifications, either by amending his original application or by submitting a new application. This permit may be modified or revoked and reissued as a result of this notification to maintain compliance with applicable state or federal regulations.

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E. Operation and Maintenance

1. Proper Operation and Maintenance

The permittee shall, at all times, maintain in good working order and operate as efficiently as possible, any facilities or systems of control installed by the permittee in order to achieve compliance with the terms and conditions of this permit. This would include, but not be limited to, effective performance based on designed facility removals, effective management, adequate operator staffing and training, adequate laboratory and process controls, and adequate funding that reflects proper user fee schedules.

2. Treatment System Failure and Upset

An upset is an affirmative defense to an enforcement action brought for noncompliance with technology-based permit effluent limitations if the permittee can demonstrate, through properly signed, operating logs or other relevant evidence, that:

- a. An upset occurred and the specific cause was identified,
- b. That the facility was properly operated and maintained at such time,
- c. The Department was notified within 24 hours of the permittee becoming aware of the upset, and
- d. The accountable party took action to reduce, eliminate and prevent a recurrence of upset, including minimizing adverse impact to waters of the state.

Removed Substances

Solids, sludge, filter backwash or other pollutants removed in the course of treatment or control of wastewater shall be disposed of at a site and in a manner approved by the Nebraska Department of Environmental Quality. The disposal of non-hazardous industrial sludges shall conform to the standards established in or to the regulations established pursuant to 40 CFR, Part 257. If solids are disposed of in a licensed sanitary landfill, the disposal of solids shall conform to the standards established in Title 132.

F. Definitions

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Administrator: The Administrator of the USEPA.

Aliquot: An individual sample having a minimum volume of 100 milliliters that is collected either manually or in an automatic sampling device.

Biweekly: Once every other week.

Bimonthly: Once every other month.

Bypass: The intentional diversion of wastes from any portion of a treatment facility.

Daily Average: An effluent limitation that cannot be exceeded and is calculated by averaging the monitoring results for any given pollutant parameter obtained during a 24-hour day.

Department: Nebraska Department of Environmental Quality.

Director: The Director of the Nebraska Department of Environmental Quality.

Industrial User: A source of indirect discharge (a pretreatment facility).

Monthly Average: An effluent limitation that cannot be exceeded, calculated by averaging the monitoring results for any given pollutant parameter obtained during a calendar month.

Publicly Owned Treatment Works (POTW): A treatment works as defined by Section 212 of the Clean Water Act (Public Law 100-4) which is owned by the state or municipality, excluding any sewers or other conveyances not leading to a facility providing treatment.

30-Day Average: An effluent limitation that cannot be exceeded, calculated by averaging the monitoring results for any given pollutant parameter obtained during a calendar month.

Total Toxic Organics (TTO): The summation of all quantifiable values greater than 0.01 milligrams per liter (mg/l) for toxic organic compounds that may be identified elsewhere in this permit. (If this term has application in this permit, the list of toxic organic compounds will be identified; typically in the Limitations and Monitoring Section(s) or in an additional Appendix to this permit.)

Toxic Pollutant: Those pollutants or combination of pollutants, including disease causing agents, after discharge and upon exposure, ingestion, inhalation or assimilation into an organism, either directly from the environment or indirectly by ingestion through food chains will, on the basis of information available to the administrator, cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunction (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring.

Upset: An exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee, excluding such factors as operational error, improperly designed or inadequate treatment facilities or improper operation and maintenance or lack thereof.

Volatile Organic Compounds (VOC): The summation of all quantifiable values greater than 0.01 milligrams per liter (mg/l) for volatile, toxic organic compounds that may be identified elsewhere in this permit. (See the definition for Total Toxic Organics above. In many instances, VOCs are defined as the volatile fraction of the TTO parameter. If the term "VOC" has application in this permit, the list of toxic organic compounds will be identified; typically in the Limitations and Monitoring Section(s) or in an additional Appendix to this permit.)

Weekly Average: An effluent limitation that cannot be exceeded, calculated by averaging the monitoring results for any given pollutant parameter obtained during a fixed calendar week. The permittee may start their week on any weekday but the weekday must remain fixed unless a change is approved by the Department.

"X" Day Average: An effluent limitation defined as the maximum allowable "X" day average of consecutive monitoring results during any monitoring period where "X" is a number in the range of one to seven days.

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G. Abbreviations

CFR: Code of Federal Regulations

kg/Day: Kilograms per Day

MGD: Million Gallons per Day

mg/L: Milligrams per Liter

NDEQ: Nebraska Department of Environmental Quality

NDEQ Title 115: *Rules of Practice and Procedure*

NDEQ Title 117: *Nebraska Surface Water Quality Standards*

NDEQ Title 118: *Ground Water Quality Standards and Use Classification*

NDEQ Title 119: *Rules and Regulations Pertaining to the Issuance of Permits Under the National Pollutant Discharge Elimination System*

NDEQ Title 121: *Effluent Guidelines and Standards*

NDEQ Title 126: *Rules and Regulations Pertaining to the Management of Wastes*

NDEQ Title 127: *Rules and Regulations Governing the Nebraska Pretreatment Program*

NDEQ Title 132: *Rules and Regulations Pertaining to Solid Waste Management*

NPDES: National Pollutant Discharge Elimination System

POTW: Publicly Owned Treatment Works

µg/L: Micrograms per Liter

WWTF: Wastewater Treatment Facility